BiPAP systems are the subject of U.S. Patents #5148802, #523995,#5313937, #5433193, Canadian Patent #2,024,477, European Patent #EP0425092, German Patent #69021681.5-08, and other pending U.S. and foreign patents. BiPAP is a registered trademark of Respironics, Inc.

RESPIRONICS BiPAP

S/T - S/T-D 20

Part Number 336064

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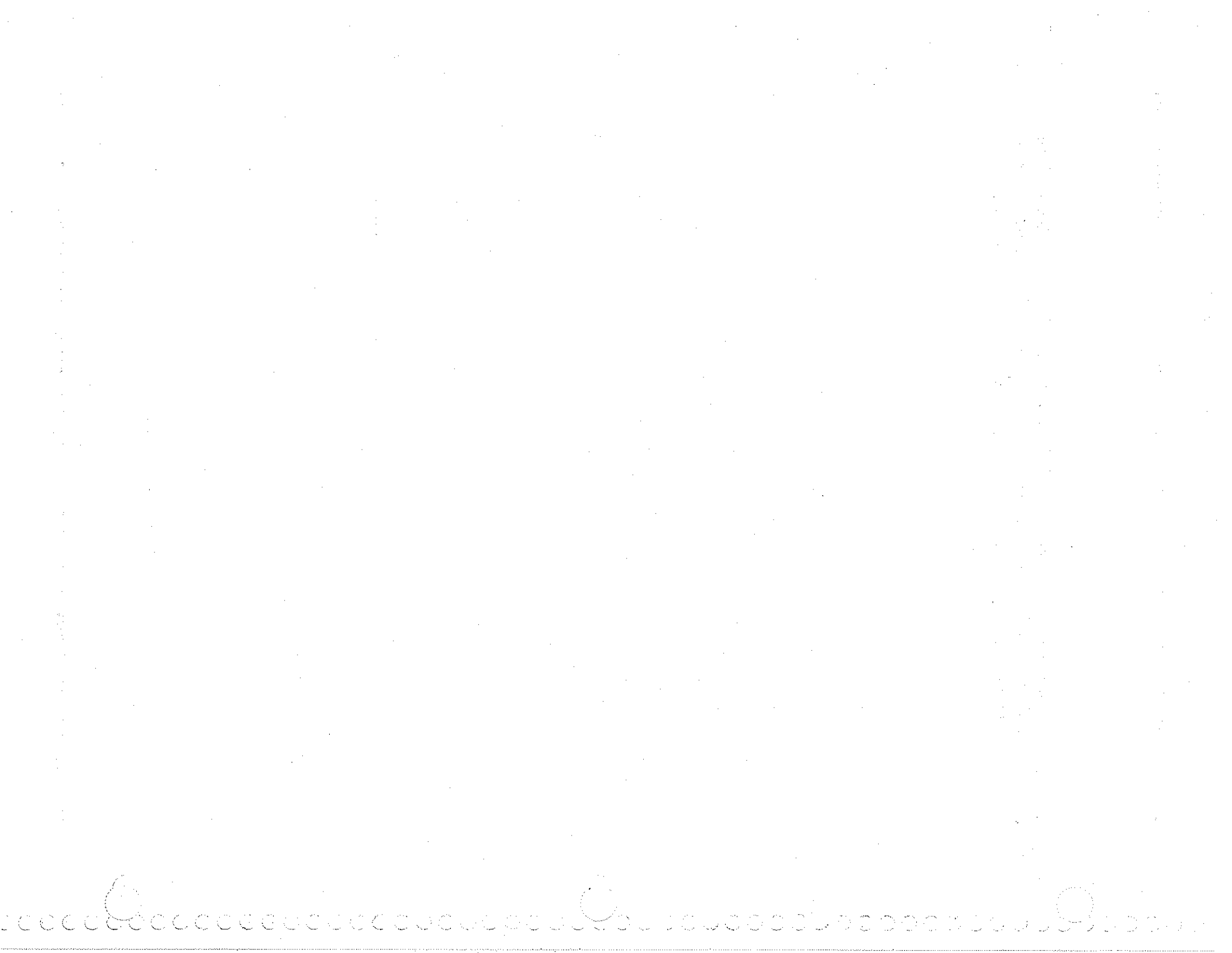

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Chapter 1 Warnings, Cautions, and Notes

1.1 Warnings

1.2 Cautions

1.3 Notes

Chapter 1: Warnings, Cautions, and Notes

WARNING: Indicates the possibility of injury to the patient or the operator.
CAUTION: Indicates the possibility of damage to the device.
NOTE: Places emphasis on an operating characteristic.

1.1 Warnings

General

- This is a service manual. It does not provide adequate information to allow proper operation of the device for use in treating patients. Please refer to the device Clinical, Dealer, and/or Patient Manuals for clinical use.

- This manual serves as a reference. It should be used in conjunction with the instructions and protocol set by the physician at the institution where the device is being used. The instructions in this manual are not intended to supersede established medical protocols regarding the use of assist ventilators.

Safety

- The information contained in this section is supplemental to the warnings, cautions, and notes contained in the Clinical, Dealer, and/or Patient Manuals for each device. Please read the appropriate device manuals prior to servicing the unit.

- The BiPAP System is intended for use on adult patients (≥ 30 kg) only.

- The BiPAP System is intended for use with a Respironics, Inc. approved patient circuit only. A Respironics approved circuit consists of :

    - smooth inner lumen tubing;
    - an exhalation device such as the Whisper Swivel® or Respironics Disposable Exhalation Port Assembly; and
    - a noninvasive patient interface (nasal mask, mouthpiece, or full face mask).

  Additional accessories may be added to the circuit to meet specific needs. Every time changes are made to the circuit configuration, the delivered pressures must be monitored at the patient connection with the unit cycling.

- When operating the BiPAP S/T-D System with the Detachable Control Panel (DCP), the DCP settings override the settings on the BiPAP S/T-D System's control panel. DO NOT connect the DCP to the BiPAP S/T-D System while the unit is turned on.

- Explosion Hazard - Do not use the BiPAP System in the presence of flammable anesthetics.

- Oxygen supports combustion. Oxygen should not be used while smoking or in the presence of an open flame.

- DO NOT add oxygen to the front of a BiPAP unit (at the inlet filter opening).

Warnings *continued*

Operation

- BiPAP System performance should be verified, as described in the Clinical Manual, before each new patient is placed on the system.
- The addition of accessories to the patient circuit (e.g., heated humidifier, bacteria filter, water traps, and additional tube lengths) degrades pressure and flow delivery at the patient connection. Confirm that the delivered pressures and flows are adequate for patient management when circuit accessories are used. It may be necessary to increase pressure delivery to compensate for the increased resistance of the circuit.
- When the BiPAP System is used with a heated humidifier, that manufacturer's specifications should be checked to confirm that the humidifier will function correctly in the presence of the continuous flow from the BiPAP System. Always position the humidifier lower than both the BiPAP unit and the patient.
- Never attach oxygen tubing or any positive pressure source to the Pressure Port on the front panel of the BiPAP S/T-D unit.

Service

- Wiring connections and adjustments should be performed by authorized service personnel ONLY.
- Repairs and adjustments MUST be performed by experienced personnel who are fully acquainted with this equipment. Service done by inexperienced, unqualified personnel or installation of unauthorized parts could cause personal injury, invalidate the warranty, or result in costly damage. Contact Respironics, Inc. or your health care dealer if the unit fails to meet performance specifications.
- To avoid electrical shock, disconnect the electrical supply before changing the fuses.
- Replace fuses with those of the same type and rating only.

Cleaning

- To avoid electrical shock, unplug the BiPAP unit before cleaning it.

1.2 Cautions

CAUTION: Federal law restricts this device to sale by or on the order of a physician.

- The DCP cable connector port is NOT a standard computer communications port. Connecting the output port to a computer could damage the computer and the BiPAP unit.
- On BiPAP S/T-D models, output signal pin connections are active. Care must be exercised to prevent electrical shorting between the pin connections.
- Only Respironics cables should be used. Use of any other cable types may cause damage to the BiPAP S/T-D System.
- For pressure monitoring, use only tubing with a smooth inner lumen.
- When transporting or storing the BiPAP System, precautions should be taken to avoid exposure to temperature extremes. If exposure to such temperatures has occurred, the unit should be allowed to come to room temperature before being turned on.
- The unit should be positioned on its base or rear panel for proper operation.
- The voltage selector switch must be set according to local line voltage and the proper fuses used.
- When using Respironics smooth inner lumen tubing without a heated humidifier, the overall length of the tubing should not exceed twelve feet.
- Regularly inspect the DCP cable.
- **Electromagnetic emissions:** BiPAP Systems have been tested and shown to comply with FCC Class B Subpart 15.J requirements and the IEC 601-1-2 requirements for electromagnetic compatibility.
- Operational verification of medical monitoring equipment used near the BiPAP System is recommended to assure that any electromagnetic interference produced by the System unit does not affect the function of the monitoring equipment.

1.3 Notes

- The Inspiratory Positive Airway Pressure (IPAP) and Expiratory Positive Airway Pressure (EPAP) controls are electrically coupled. The unit will not deliver an EPAP level that is higher than the set IPAP level. If the EPAP control is set higher than IPAP, the unit will be locked to the IPAP setting and the IPAP Light Emitting Diode (LED) will remain lit.
- Circuit tubing with a smooth inner lumen and a nominal diameter of 22 mm is recommended. Tubing with a corrugated inner lumen will cause a pressure drop from the blower outlet to the patient connection. This may affect the unit's ability to deliver the maximum pressure.
- Heat and moisture exchangers should not be used with the BiPAP System. Testing has shown that the ability of the unit to maintain the prescribed pressure is significantly affected by the addition of a heat and moisture exchanger to the patient circuit.

Additional Warnings, Cautions, and Notes are located throughout this manual.

Chapter 2 BiPAP System

2.1 Identifying the BiPAP System Unit

2.2 BiPAP System Specifications

2.3 System Description

2.4 System Components

2.1 Identifying the BiPAP System Unit

Respironics identifies units with two numbers: the Model Number and the Part Number.

The **Model Number** is printed on a label on the bottom left of the rear end cap.

The **Part Number** (also known as the finished goods number) is indicated on this list by model number. The Part Number is the number used to order the BiPAP system, and is the number that must be used if a unit is returned to Respironics.

Part Number	Product Description
Model 332003	
332110	BiPAP S/T-D — US/CAN Clinical System
332098	BiPAP S/T-D — US/CAN Research Demo
332105	BiPAP S/T-D — US/CAN Clinical Demo
332268	BiPAP S/T-D — US/CAN Hospital Core Package
332305	BiPAP S/T-D — CSA Clinical System with DCP
Model 332083	
332407	BiPAP S/T-D — Australian System
332055	BiPAP S/T-D — International Clinical System
332266	BiPAP S/T-D — LGA Hospital Core Package
332099	BiPAP S/T-D — International Clinical Sample
332392	BiPAP S/T-D — International Hospital Core Package
Model 332109	**NOTE:** As of S/N 28235, Model 332109 is obsolete
332074	BiPAP S/T Home Starter Kit — US Home System
	NOTE: As of S/N 28235, Part Number 332074 becomes US/CAN Home System; see Model Number 332203
Model 332203	
332056	BiPAP S/T — CAN Home System
	NOTE: As of S/N 28235, Part Number 332056 is obsolete
332074	BiPAP S/T — US/CAN Home System — As of S/N 28235
Model 332108	
332054	BiPAP S/T — International Home System
332406	BiPAP S/T — Australian Home System
Model 332408	
332409	BiPAP S/T — LGA Home System

Part Number	Product Description
Model 332092	
332069	BiPAP S-D — US/CAN Clinical System
332146	BiPAP S-D — US/CAN Sample
332212	BiPAP S-D — Unit Sample
332262	BiPAP S-D — US/CAN Sample
332303	BiPAP S-D — US/CAN Clinical System with DCP
332298	BiPAP S-D — Clinical Sample with DCP
Model 332095	
332023	BiPAP S-D — International Clinical System
332304	BiPAP S-D — TUV Clinical System with DCP
332405	BiPAP S-D — Australian Diagnostic System
Model 332019	**NOTE:** *As of S/N 28329, Model 332019 is obsolete*
332100	BiPAP S — US Home System
	NOTE: As of S/N 28329, Part Number 332100 becomes US/CAN Home System; see Model 332202
Model 332079	
332073	BiPAP S — International Home System
332404	BiPAP S — Australian Home System
Model 332202	
332072	BiPAP S — CAN Home System
	NOTE: As of S/N 28329, Part Number 332072 is obsolete
332100	BiPAP S — US/CAN Home System — As of S/N 28329
Model 332252	
332231	BiPAP S/T — International Xemko Home System
Model 332201	
332197	BiPAP S — International Xemko Home System

2.2 BiPAP System Specifications

MODELS:	S/T, S/T-D, S, S-D
FUNCTIONS:	
IPAP	Delivers set pressure continuously. (IPAP-Inspiratory Positive Airway Pressure)
EPAP	Delivers set pressure continuously. (EPAP-Expiratory Positive Airway Pressure) The IPAP and EPAP controls are electrically coupled. The unit will not deliver an EPAP level that is higher than the set IPAP level. If the EPAP control is set higher than IPAP, the unit will be locked to the IPAP setting and the IPAP Light Emitting Diode (LED) will remain lit.
Modes	Spontaneous Mode (all models) Spontaneous/Timed Mode (S/T and S/T-D models only) Timed Mode (S/T and S/T-D models only)
Zero	(S/T-D and S-D models with DCP only): Provides "0" reference signal to the $\dot{V}_{tot}$, $\dot{V}_{est}$, and VT channels. Circuit pressure is controlled by the EPAP setting.
Cal.	(S/T-D and S-D models only): Provides an alternating square wave signal with a period of four seconds and an amplitude of ±0.5V to the $\dot{V}_{tot}$ and $\dot{V}_{est}$ channels. Sends a corresponding triangular wave volume signal of $0.5V_{pp}$ to the VT channel. Circuit pressure is controlled by the EPAP setting.
PRESSURES AND FLOW CHARACTERISTICS (all models):	
Pressure range for IPAP or EPAP	4 cm H_2O to 20 cm H_2O at ±60 L/min flow* Pressure controls are electronically coupled so that the unit will not deliver a higher EPAP than IPAP level.
Pressure Calibration Accuracy	±2 cm H_2O of the indicated control setting.
Pressure Setting Stability	±1 cm H_2O over 8 hours.

NOTE: All pressure measurements were made at the blower outlet unless stated otherwise.

*Measured at the end of a six-foot section of smooth inner lumen tubing.

CYCLING:	
Breaths Per Minute	(S/T and S/T-D units only): 4 to 30 BPM.
Breathing Rate Accuracy	(S/T and S/T-D units only): ±10% or 2 BPM of indicated reading, whichever is greater.
% IPAP	(S/T and S/T-D units only): 10 to 90%.
% IPAP Setting Accuracy	(S/T and S/T-D units only): ±10% of indicated setting.
Minimum IPAP Time	(all units): Approximately 200 msec (Spontaneous and Spontaneous/Timed modes only).
Maximum IPAP Time	(all units): 3 seconds ±0.5 second at a constant flow rate condition of 100 liters/min (Spontaneous and Spontaneous/Timed modes only).
Minimum EPAP Time	(all units): 500 msec ±75 msec (Spontaneous and Spontaneous/Timed modes only).
Spontaneous Inspiratory Effort Threshold	(all units): 47.5 cc/sec above the average leak flow rateof 14L/min, maintained for 30 msec (Spontaneous and Spontaneous/Timed modes only).
PATIENT CIRCUIT:	
Whisper Swivel Continuous Leak Rate	**Pressure** / **Nominal Leak** 5 cm H_20 — 14 L/min (nominal) 10 cm H_20 — 21 L/min (nominal) 15 cm H_20 — 26 L/min (nominal) 20 cm H_20 — 30 L/min (nominal)
ELECTRICAL REQUIREMENTS:	100-130 VAC (60Hz) or 200 to 260 VAC (50Hz). (Voltage range set by voltage selector switch on rear panel.)
Current Consumptions:	800mA max. for 100 to 130 VAC 400mA max for 200 to 260 VAC Designed to ECRI Electical Safety Specifications. Ground Continuity: <500 milliohms (45 typical) Current Leakage: <100 microamps (8.2 typical)
Electromagnetic Emissions:	BiPAP Systems have been tested and shown to comply with FCC Class B Subpart 15.J requirements and the IEC 601-1-2 requirements for electromagnetic compatibility.
Fuse Ratings: Serial Numbers<200,000	**1A Fuses -- 115 Volt Electrical Systems** **500mA Fuses -- 230 Volt Electrical Systems**
Serial Numbers>200,000	**800mA Fuses --115 Volt Electrical Systems** **400mA Fuses -- 230 Volt Electrical Systems**
OPTIONAL DCP CABLES:	26 AWG (minimun) tinned copper, shielded, insulated wire.

PHYSICAL CHARACTERISTICS:	
Unit dimensions.....	7 ¾ x 9 x 12 3/16 inches (20 x 23 x 31 cm). 850 cubic inches (13,931 cubic cm).
Weight.....	9.5 lbs (4.3 kg).
Operating Temperature.....	50 to 100 °F (10 to 38 °C).
Storage Temperature.....	-20 to 140 °F (-30 to 60 °C).
Outlet Temperature.....	It is normal for the pre-foam BiPAP unit to have an outlet air temperature that is 10 to 12 °F warmer than room temperature, especially after running all night. A difference between room temperature and air outlet temperature greater than 18 °F is an indication for a service check. Foamed units (serial numbers 052000 or greater) can be expected to have an outlet air temperature that is 18 to 25 °F warmer than room temperature, especially after running all night. A difference between room temperature and air outlet temperature greater than 25 °F is an indication for a service check on a foamed BiPAP unit. The air temperature at the end of a patient circuit will always be lower than the temperature measured at the outlet and is typically 5 to 10 °F above ambient.
Noise Level.....	Variables associated with noise measurement are numerous and therefore no specification is provided.

2.3 System Description

This BiPAP unit provides bi-level positive airway pressure, through a nasal or nasal /oral mask, to assist patient ventilation. An integral flow transducer senses whether the patient is inhaling or exhaling by constantly monitoring the amount of air flowing through the system. The system then provides the appropriate amount of positive air pressure for the function, i.e., more pressure during inhalation (IPAP), less pressure during exhalation (EPAP).

The unit is available in four models: BiPAP S, BiPAP S/T, BiPAP S-D, BiPAP S/T-D.

The BiPAP S unit offers two modes of operation:

- CPAP (Continuous Positive Airway Pressure) - When the control is set to either IPAP or EPAP, the unit provides continuous pressure at the level you set for that function.
- SPONTANEOUS - The unit cycles between inhalation (IPAP) and exhalation (EPAP) levels as triggered by patient breathing.

The BiPAP S/T offers four modes of operation:

- CPAP (Continuous Positive Airway Pressure) - When the control is set to either IPAP or EPAP, the unit provides continuous pressure at the level you set for that function.
- SPONTANEOUS - The unit cycles between inhalation (IPAP) and exhalation (EPAP) levels as triggered by patient breathing.
- SPONTANEOUS/TIMED - As with the SPONTANEOUS mode, the unit cycles between IPAP and EPAP levels as sensed from patient breathing, but if the patient does not inhale within a preset time interval, the unit cycles to IPAP. The time interval is determined by the BPM (breaths per minute) setting on the control panel.
- TIMED - The unit cycles between IPAP and EPAP levels at preset time intervals, determined by the BPM and % IPAP (percent of breath cycle spent in IPAP settings on the control panel).

The BiPAP S-D unit offers the same operating modes as the BiPAP S, but all functions can be controlled by a Detachable Control Panel (DCP). In addition, the following DC analog output signals are provided for a recorder or oscilloscope:

- P (Pressure) - The signal from the internal pressure transducer indicates IPAP and EPAP levels (in cm H_2O at the measure point in the patient circuit).
- V_T (Estimated Tidal Volume) - Signal from the internal flow transducer indicates volume of air (in liters) inhaled or exhaled with each breath during quiet breathing.
- $\dot{V}_{tot}$ (Total Flow Rate) - The signal from the internal flow transducer indicates total air flow rate (in L/min) through the unit to the patient circuit. Total air flow consists of the air flow necessary to satisfy circuit leaks ($\dot{V}_{leak}$), and patient breathing ($\dot{V}_{est}$).
- $\dot{V}_{est}$ (Estimated Patient Flow Rate) - The signal from the internal flow transducer indicates patient flow rate (in L/min). The data is based on Total Flow Rate ($\dot{V}_{tot}$) minus Estimated Leak Flow Rate ($\dot{V}_{leak}$).

The BiPAP S/T-D unit offers the same operating modes as the BiPAP S/T, but all functions can be controlled by a DCP. In addition, it provides the same recorder output signals (V_T, $\dot{V}_{tot}$, $\dot{V}_{est}$, and P) as the BiPAP S-D.

The Airway Pressure Monitor is designed to supplement patient monitoring during ventilation with the BiPAP S/T-D System. Its purpose is to notify medical personnel and/or user of undesirably LOW (as in a disconnect situation) or HIGH pressures at a specific point in the breathing cycle.

Optional Detachable Control panels (DCP) are available for the BiPAP S/T-D and the BiPAP S-D units. They allow all control settings to be made and/or adjusted remotely. Some units may use the Remote Control Unit (RCU). All information relating to the DCP is applicable to the RCU.

	Model			
Feature	**S**	**S-D**	**S/T**	**S/T-D**
CPAP	Y	Y	Y	Y
Spontaneous	Y	Y	Y	Y
Spontaneous/Timed	N	N	Y	Y
Timed	N	N	Y	Y
DCP Contol	N	Y	N	Y

The table above indicates which features are present in the BiPAP model you are using. A "Y" in the column means that feature is present in that model. A "N" means that that feature is not present in that model.

2.4 System Components

Figure 2-1 shows the main system components, and Figure 2-2 shows the system air flow.

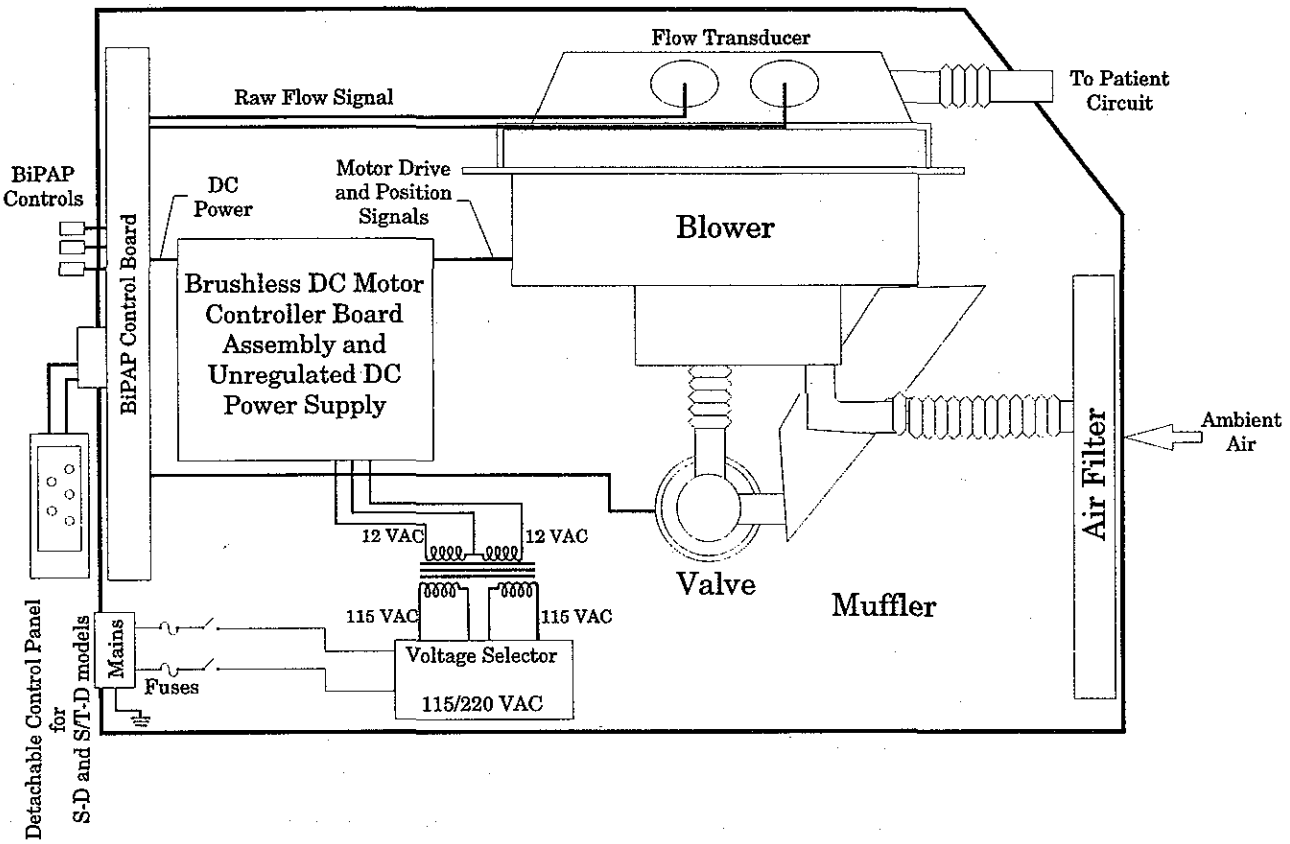


Figure 2-1. System Components.

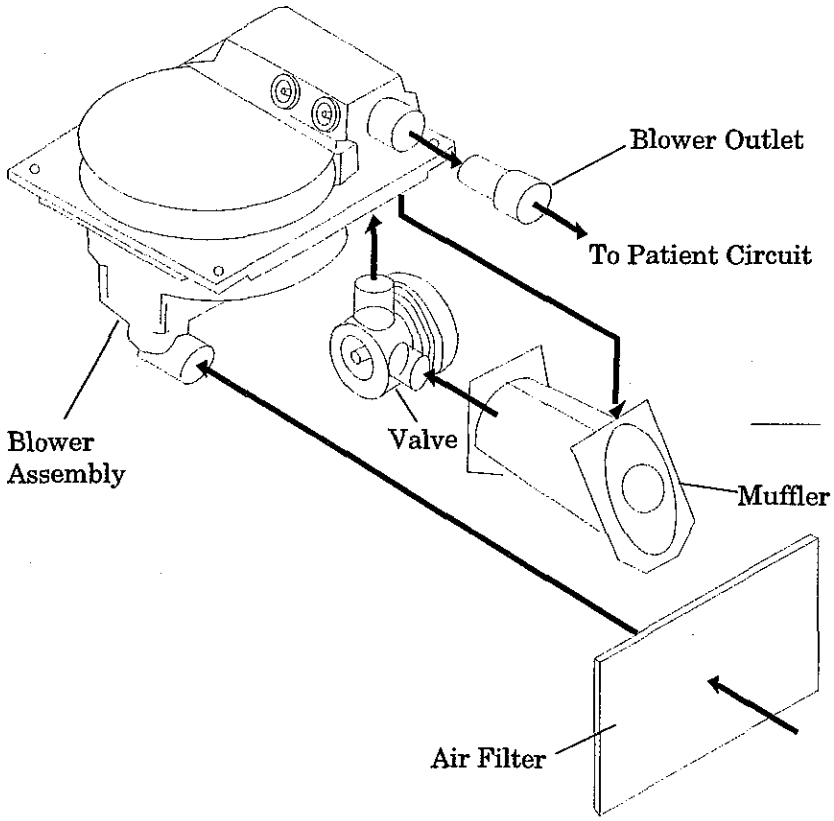


Figure 2-2. System Air Flow.

Chapter 3 Controls and Set-up

3.1 Controls

3.2 Setting Up the BiPAP System

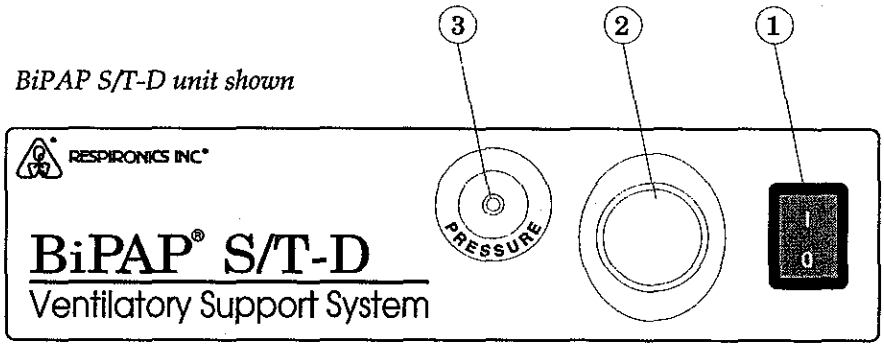
3.3 Detachable Control Panel (DCP)

3.4 DCP Set-up

3.1 Controls

3.1.1 Front Panel

BiPAP S/T-D unit shown



(1) Power Switch

The power switch turns the electrical power to the BiPAP unit ON (I) and OFF (0).

(2) Tubing Connector

The tubing connector accepts 22 mm I.D. tubing with a smooth inner lumen and accepts a mainflow bacteria filter.

(3) Pressure Port (S/T-D and S-D units only)

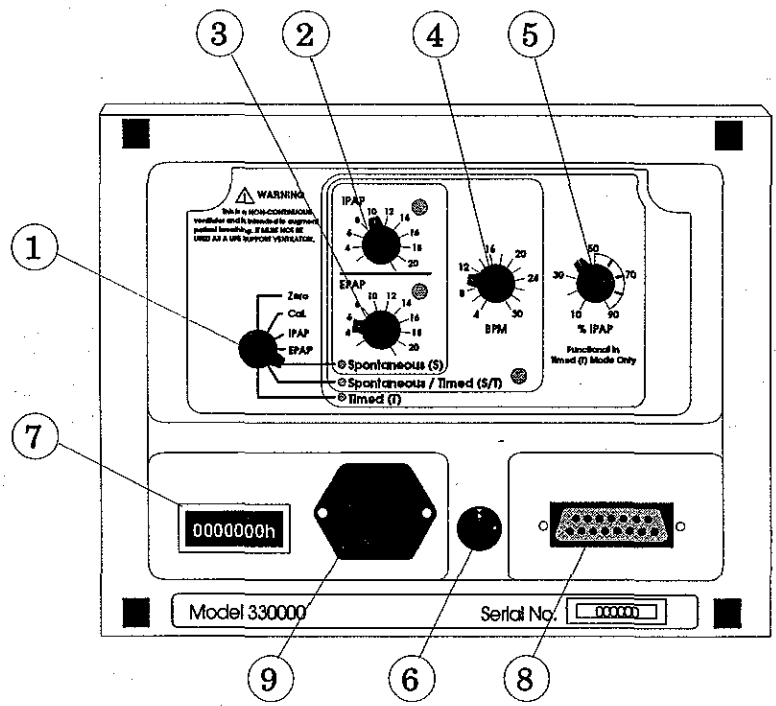
The pressure port accepts manometer tubing with a smooth inner lumen. The port interfaces with an internal pressure transducer and allows in-line pressure monitoring with output to a recorder. The pressure port is the source of the pressure display for the Detachable Control Panel (DCP).

Range = 0 to 20 cm H_2O.

CAUTION: Never add oxygen or any positive pressure source to this connection.

3.1.2 Rear Panel Controls

BiPAP S/T-D unit shown



(1) Function Selector Knob

The position of the knob indicator determines which function or mode is active. The S/T-D and S-D models function selection knobs have seven discrete positions. The S/T models function selection knobs have five discrete positions.

Zero Position — *S/T-D and S-D models only:* *For use in recorder calibration. Sends a "0" reference signal to* the Estimated Tidal Volume (V_T), Total Flow rate ($\dot{V}_{tot}$), and Estimated Patient Flow Rate ($\dot{V}_{est}$) channels. Pressure in the patient circuit is controlled by the EPAP setting.

Cal. Position — S/T-D and S-D models only: For use in recorder calibration. Sends an alternating square wave signal of +0.5 V (+30 L/min) and -0.5 V (-30 L/min) to the $\dot{V}_{tot}$ and $\dot{V}_{est}$ channels. Sends a corresponding triangular wave volume signal of 0.5 V_{pp} to the V_T channel. Pressure in the patient circuit is controlled by the EPAP setting.

IPAP Position: Inspiratory Positive Airway Pressure. With the Function Selector Knob in this position, the set pressure is delivered continuously at the IPAP level. The EPAP setting is not active.

EPAP Position: Expiratory Positive Airway Pressure. With the Function Selector Knob in this position, the set pressure is delivered continuously at the EPAP level. The IPAP setting is not active.

Spontaneous (S) Mode: When set at this mode, the adjacent LED is illuminated. Active controls are IPAP and EPAP.

Spontaneous/Timed (S/T) Mode: When set at this mode, the adjacent LED is illuminated. Active controls are IPAP, EPAP, and BPM.

Timed (T) Mode: When set at this mode, the adjacent LED is illuminated. Active controls are IPAP, EPAP, BPM, and % IPAP.

(2) IPAP Control

Active when the Function Selector Knob is in any of these four positions:

IPAP, S, S/T, or T.

When the BiPAP unit is delivering IPAP, the adjacent LED is illuminated.
Range = 4 to 20 cm H_2O.

(3) EPAP Control

Active when the Function Selector Knob is in any of these four positions:

EPAP, S, S/T, or T.

When the BiPAP unit is delivering EPAP, the adjacent LED is illuminated.
Range = 4 to 20 cm H_2O.

NOTE: The IPAP and EPAP controls are electrically coupled. The unit will not deliver an EPAP level that is higher than the IPAP level. If the EPAP control is set higher than IPAP, the BiPAP unit is locked to the IPAP setting and the IPAP LED remains lit. This is active throughout the S, S/T and T settings on the Function Selector Knob.

(4) BPM Control

Active when the Function Selector Knob is positioned in either the S/T or the T mode.
Range = 4 to 30 BPM.

S/T Mode: The BPM control sets a time interval for delivery of a breath by the BiPAP System. If the patient initiates a spontaneous breath, the BPM timer is reset. If the patient does not initiate a spontaneous IPAP trigger within the interval set by the BPM control, the BiPAP unit initiates a time-triggered breath. The BPM timer is reset with each transition from EPAP to IPAP whether the transition is triggered by the patient or by the BPM control setting. The adjacent LED illuminates to indicate timer-initiated IPAP transitions.

T Mode: All breathing cycle changes (e.g. IPAP to EPAP) are controlled by the BPM timer. The BPM LED is not active. The % IPAP control must also be set.

(5) % IPAP Control

Active when the Function Selector Knob is in the T mode. This control works in conjunction with the BPM control and determines the fraction of the respiratory cycle spent in IPAP.

Range = 10 to 90%

NOTE: For % IPAP values greater than 50%, time spent at IPAP will exceed the time spent at EPAP.

(6) Voltage Selector Switch

Set this switch to the appropriate line voltage:
United States and Canada — 115 Volts
European and other countries — Check the country's line voltage requirements for the correct setting.

(7) Elapsed Time Indicator

Provides resolution to 0.1 hour. Runs only when the main power switch is turned on.

(8) DCP Cable Connector

S-D and S/T-D units only: DB15 female connector interfaces to an optional Detachable Control Panel (DCP) that duplicates the BiPAP S/T-D control panel.

CAUTION: The DCP connector is NOT a standard computer communications port. Connecting the connector to a computer could damage the computer and the BiPAP Unit.

(9) AC Inlet/Fuse Holder

Electrical input for the power cord.

Holds two fuses of appropriate rating for the country of operation. See Section 2.2 for fuse ratings.

3.2 Setting Up the BiPAP System

Step 1 See Figure 3-1. Connect the inlet of a bacteria filter to the airflow outlet port on the front of the BiPAP unit. Connect one end of the tubing to the outlet of the bacteria filter.

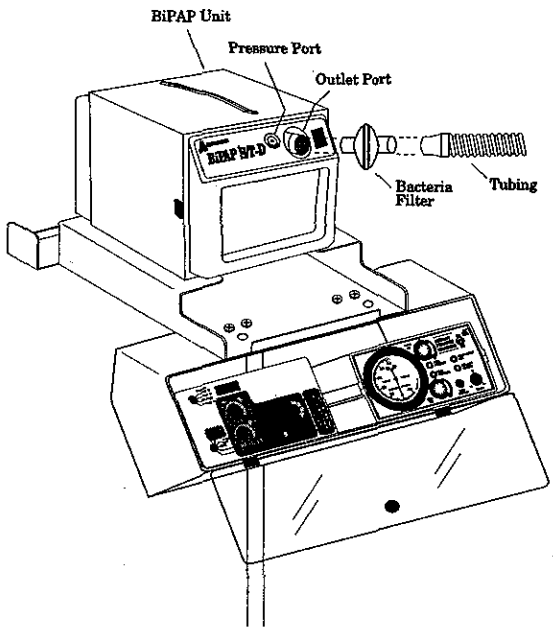


Figure 3-1. Typical Hospital System on a Stand.

To help protect the unit from contamination, place a low resistance main flow bacteria filter on the outlet of the blower. The filter must be positioned in the circuit so that it is filtering air directly from the unit. It should not be placed in the circuit between the outlet of the humidifier and the patient, since this can cause an increase in filter resistance.

The addition of a low resistance main flow bacteria filter does not have any effect on the trigger sensitivity of the system. Dependent upon the degree of resistance imposed by the filter, the pressure stability (the ability of the unit to maintain the delivered pressure within specified tolerances) may be affected. The filter must remain clean and dry to minimize the circuit effects. The dirty main flow bacteria filter should be replaced in accordance with the manufacturer's specifications and instructions.

The bacteria filter should be in-line when the pressure settings are determined. If a filter is added to a system already in use, observe the patient pressure to determine whether the settings should be adjusted to compensate for any effect of the filter.

Step 2 Assemble the patient circuit as shown in Figure 3-2. Position the circuit so that the gas vents on the side of the swivel (or exhalation port) are facing away from the patient's face.

WARNING: The continuous flow exhalation port (i.e., Whisper Swivel) is designed to exhaust CO_2 from the patient circuit. Continuous flow is required for safe operation. DO NOT BLOCK OR OTHERWISE TRY TO SEAL THE GAS VENTS OR THE EXHALATION PORT.

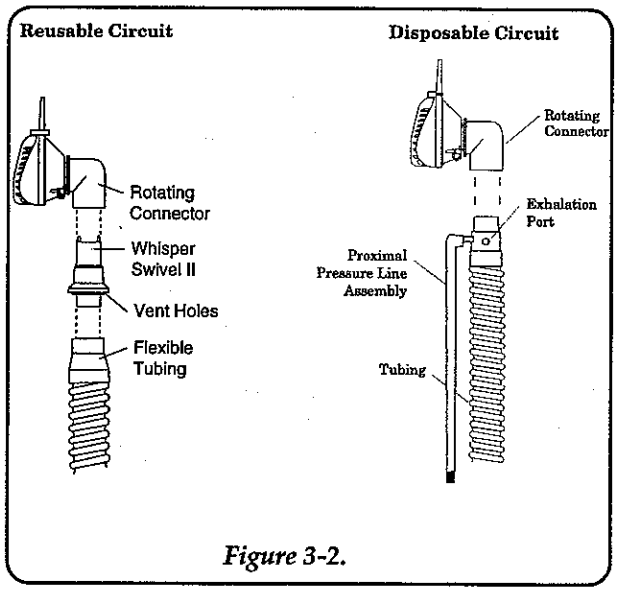


Figure 3-2.

WARNING: Each time changes are made to the circuit configuration, confirm that delivered pressures are adequate for patient management.

WARNING: The addition of accessories to the patient circuit (i.e., heated humidifier, bacteria filter, water traps, and additional tube lengths) degrades pressure and flow delivery at the patient connection. Clinical assessment must confirm that the delivered pressures and flows are adequate for patient management when circuit accessories are used. It may be necessary to increase pressure delivery to compensate for the increased resistance of the circuit.

NOTE: The Whisper Swivel has evolved through several designs, including:

- 3 slots cut at an angle
- 3 slots cut at an angle with 2 raised ridges perpendicular to the slots
- over-lapping collar

All of these designs are acceptable to use.

NOTE: Heat and moisture exchangers should not be used with the BiPAP System. Testing has shown that the ability of the unit to maintain the prescribed pressure is significantly impacted by the addition of a heat moisture exchanger to the patient circuit.

Step 3 Plug the electrical cord into the power connector on the back of the unit. Figure 3-4.

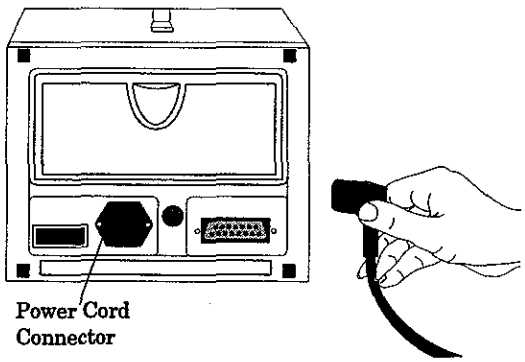


Figure 3-4

Step 4 Make sure the voltage selector switch on the back of the unit is set correctly. Figure 3-5.

United States and Canada setting: 115 V
Europe and other countries: Check the country's line voltage requirements for the correct setting.

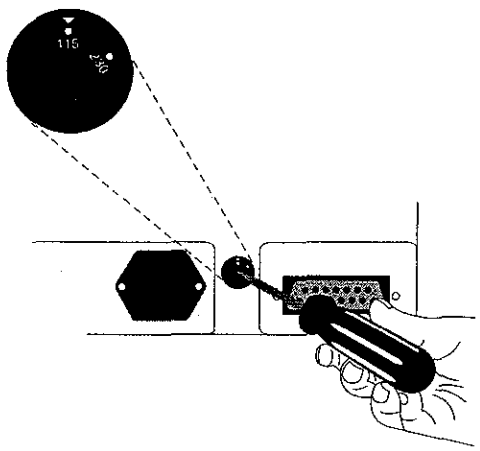


Figure 3-5

Step 5 Make sure the ON/OFF switch is OFF (0), then plug the electrical cord into a three-prong outlet. Figure 3-6.

NOTE: In the United States and Canada, the use of a three-prong to two-prong adapter or extension cord is not recommended.

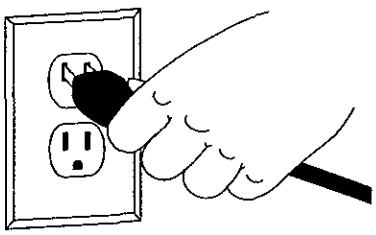


Figure 3-6

Step 6 **S/T-D units only—Connecting a Recorder:**

If you are using a Detachable Control Panel (DCP), refer to the DCP instruction manual for details on connecting a recorder.

Step 7 Turn the unit on, occlude the outlet port, and confirm the presence of flow from the exhalation port.

3.3 Detachable Control Panel (DCP) (Optional)

The DCP is an optional accessory available for use with the BiPAP S-D and S/T-D units. The DCP combines all the functional controls found on the rear of the BiPAP unit, and includes a selectable display that provides pressure, estimated exhaled tidal volume, and estimated circuit leak data. The DCP allows the operator to make adjustments to settings from a remote location. Output connectors that allow the Patient Output Signals to be displayed on a recorder can be found on the side of the DCP. Some units may use the Remote Control Unit (RCU). All connection information regarding the DCP is applicable to the RCU.

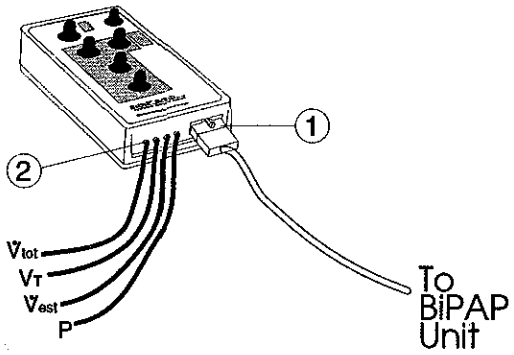


Figure 3-7. Detachable Control Panel.

(1) DCP Cable Connector

Accepts the BiPAP System Remote cable from the unit. When the BiPAP unit is plugged in and turned on, electrical power is provided to the DCP via the cable.

CAUTION: Do not connect or disconnect the DCP into the BiPAP unit while the unit is turned on.

The DCP control settings override the BiPAP unit settings.

CAUTION: The BiPAP DCP cable connector port is NOT a standard computer communications port. Connecting the output port to a computer could damage the computer and the BiPAP System.

Adjust the control settings appropriately before placing the patient on the BiPAP circuit.

(2) Output Jack

Transmits Patient Output Signals from the BiPAP unit to a recorder. Four separate recorder cables are available so that only the desired signals need to be accessed. One end of the cable is equipped with a sub-miniature phone plug that connects to the Output Jack. On the other end, cable terminations appropriate for your equipment are available from Respironics.

CAUTION: Wiring connections and adjustments should be performed by authorized hospital personnel only.

Pressure (P) Signal: 0.10 V = 1 cm H_2O Range: 0 to 25 cm H_2O

Estimated Patient Flow Rate ($\dot{V}_{est}$) Signal: 1.0 V = 60 L/min Range = ±150 L/min

Estimated Tidal Volume (V_T) Signal: 1.0 V = 2 liters Range = 0 to 4 liters

Total Flow Rate ($\dot{V}_{tot}$) Signal: 1.0 V = 60 L/min Range = ±150 L/min

3.4 DCP Set-up

NOTE: Refer to the DCP Instruction Manual for detailed set-up and operation instructions.

Step 1 Make sure that the main power switch is set to OFF (0), then attach the DB15 male connector end of the BiPAP/DCP cable to the DCP cable connector on the back of unit. Attach the other end of the cable to the DCP as shown in Figure 3-8.

Step 2 Attach the patient circuit to the unit as explained in Section 3.2.

Step 3 To obtain output signals to a recorder, connect the DCP/recorder cables to the output jacks on the DCP as shown in Figure 3-9. Connect the other ends of the cables to the recorder according to recorder manufacturer's instructions.

Step 4 If a pressure (P) output signal is desired, connect a length of smooth inner lumen manometer tubing, equal in length to the patient circuit tubing, to the port provided on the patient mask. Attach the other end of the tubing to the pressure port on the front of the BiPAP unit.

CAUTION: The DCP settings (S/T-D and S-D units only) override the settings on the BiPAP unit's control panel. Adjust the DCP settings approximately before setting up the patient on the BiPAP circuit. DO NOT connect the DCP unit to the BiPAP while the unit is turned on.

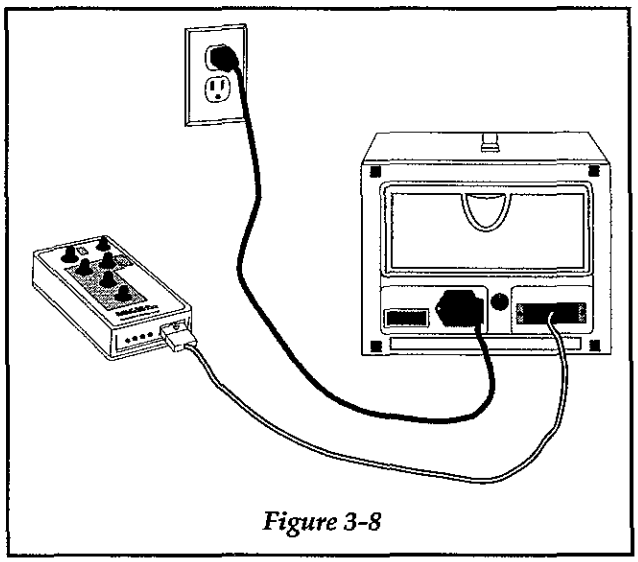


Figure 3-8

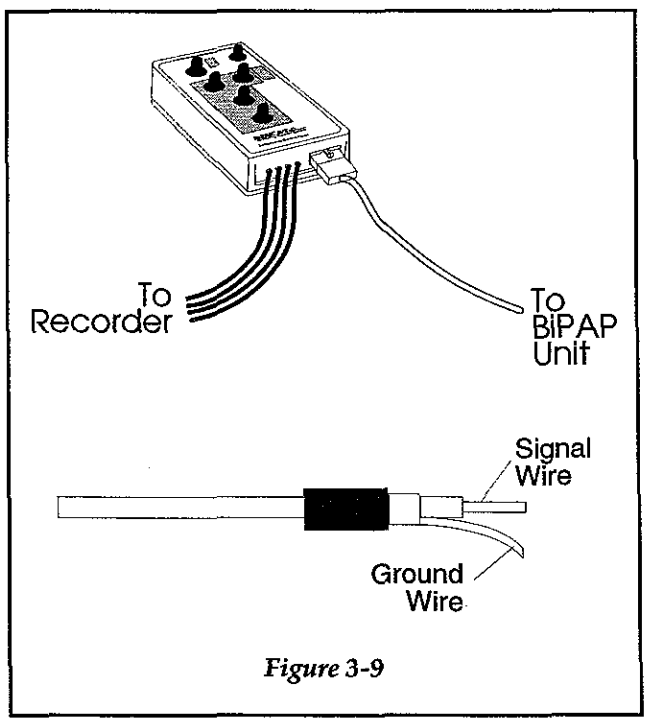


Figure 3-9

Chapter 4 Maintenance

4.1 Maintenance Schedule

4.2 Maintenance Procedures

Chapter 4: Maintenance

4.1 Maintenance Schedule

The Maintenance Schedule on page 4-2 lists the items that must be periodically inspected or replaced. Use the Log to record the dates you perform the maintenance items. You may photocopy the Maintenance Log for each unit you service.

RESPIRONICS INC.®

BiPAP Preventive Maintenance Schedule

(Factory Recommended)

Patient _____ Servicing Agent _____

Address _____ Address _____

_____ _____

Phone _____ Phone _____

Model _____ Serial# _____ Date Purchased _____

Refer to Section 4.2 of this manual for maintenance and service instructions.

Maintenance Item	Service Interval	Date				
Record hours on meter. See 4.2.1.	At set-up, maintenance, or service					
Verify voltage selector switch. See 4.2.2	At set-up					
Test Unit Control Functions See 4.2.4	Annually					
Inspect fuses. See 4.2.3	Annually					

4.2 Maintenance Procedures

4.2.1 Recording the Hours on the Time Meter

See Section 3.1 for the location and description of the Time Meter.

4.2.2 Verifying the Voltage Selector Switch Setting

See Section 3.1 for the location and description of the Voltage Selector Switch.

4.2.3 Changing the Fuses

Inspect the fuses yearly. Check for blackened areas on the glass. If the fuses appear blackened, or if the unit fails to run when the switch is on, change the fuses. Verify that the value of the fuse meets the specification.

The fuses are located in the back of the unit under the AC connector. See section 2.2 for fuse ratings.

WARNING: To avoid electrical shock, disconnect the electrical supply before changing the fuses.

Step 1 Remove the fuse holder by pushing in on the small tabs on the sides of the holder as shown in Figure 4-1. (Or pushing down from the top. See Figure 4-3.)

Step 2 Pull the fuse holder completely out of the unit as shown in Figure 4-2..

Step 3 Replace the old fuses with new fuses of the same type and rating.

Step 4 Insert the fuse holder back into the unit as shown in Figure 4-2

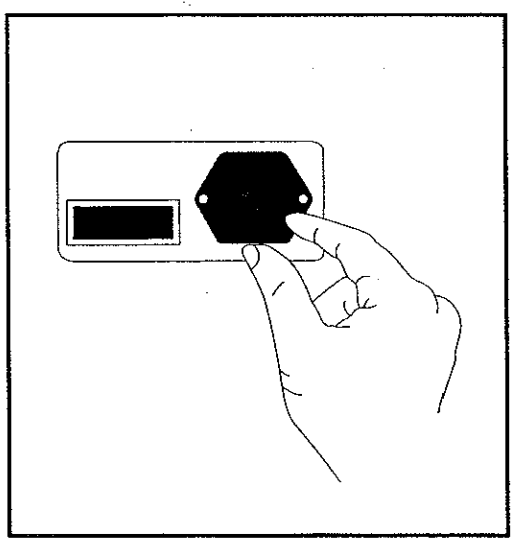


Figure 4-1

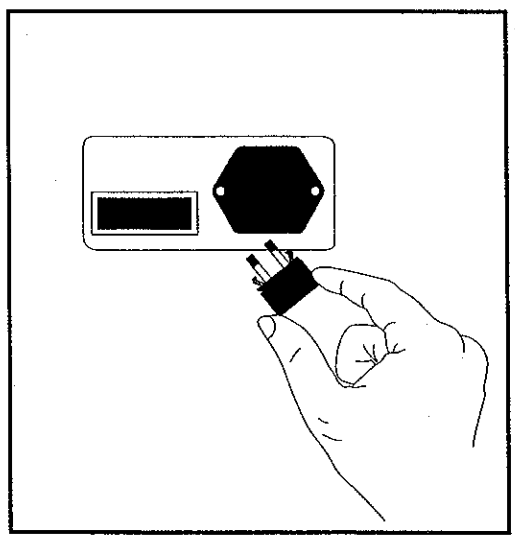


Figure 4-2

Some BiPAP units have an AC Inlet Fuse Drawer without side clips, to remove it, use a straight head screw driver rather than squeezing the side clips on the drawer. For most units use the following steps:

Step1 Use a flatblade screwdriver to pry the fuse holder out of the retainer. See Figure 4.3.

Step 2 Grasp the esposed sides of the fuse holder and pull it completely out of the unit.

Step 3 Replace the old fuses with new fuses of the same type and rating.

Step 4 Push the fuse holder back into the unit until it snaps into place. See Figure 4.2.

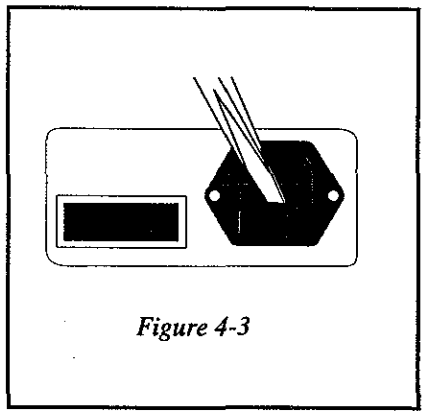


Figure 4-3

4.2.4 Test Control Functions

As a minimum test, perform the BiPAP 20 System Screening Procedure in Appendix C. As a more rigorous test, you may choose to perform the System Test in Chapter 7. Perform only the Final Test, in which only measurements are taken and no adjustments are made.

4.2.5 Notes to Maintenance Procedures

Section 4.2.1 to 4.2.4 are preventive maintenance procedures for the BiPAP 20 unit only. There are user care activities that the user or caregiver may do but are not specifically required as part of the preventive maintenance schedule. For more information, see the BiPAP 20 User Guide. These activities include:

- Cleaning the exterior of the unit when visibly dirty. See Section 4.2.6 of this manual.
- Replacing the disposable filter every 30 days of use, or when visibly dirty. See Section 4.2.7 of this manual.
- Clean and inspect the mask, tubing, and accessories daily according to their individual instruction sheets.
- Clean and inspect Softcap®, chin strap, and headgear weekly according to their individual instruction sheets.

For more information about these accessories, refer to the individual instruction sheets or to the User Circuit Accessories Guide.

4.2.6 Cleaning the BiPAP 20 Unit

CAUTION: Do not clean any parts of the system with alcohol or cleaning solutions containing alcohol. These cleaning processes may harden or deform the flexible plastic parts of the system and adversely affect their function. Do not clean the system by steam autoclave or gas sterilization methods.

CAUTION: Unplug the BiPAP 20 before cleaning it. Do not immerse it in water or allow any liquid to enter the cabinet. Do not get the filter wet.

Step 1 Using a cloth slightly dampened with water and a mild dish detergent and standard hospital-grade disinfectant, wipe the outside of the BiPAP 20 enclosure.

Step 2 Let the BiPAP 20 dry before plugging it in again.

4.2.7 Changing the Filter

CAUTION: Failure to replace a dirty filter may cause high operating temperatures in the BiPAP unit, may reduce the flow, and may reduce the output pressure.

The white filter on the front of the BiPAP is disposable and should be replaced after thirty days of use or sooner if it is especially dirty. One extra filter is included with the clinical system.

Step 1 Turn the BiPAP unit OFF (0) and unplug the electrical cord from the wall outlet and from the back of the unit.

Step 2 See Figure 4-4. Press down (1) and pull out (2) on the top of the Whisper Cap. You need to press down only about 1/8" to allow the top lip of the Whisper Cap to clear the filter retainer.

Step 3 Pull up (3) on the bottom of the Whisper Cap until the bottom lip clears the filter retainer.

Step 4 See Figure 4-5. Locate the button in the center of the filter holder beneath the surface of the filter. Push in on the button and pull the filter out from all four sides of the filter holder.

Step 5 Throw away the dirty filter. The filter is not washable.

Step 6 Center a new filter over the filter holder. Carefully push in on the center button and tuck the filter in on all four sides as shown in Figure 4-6.

Step 7 Release the button. The filter should be intact and fit securely, covering the entire holder. Remove and readjust the filter if necessary.

Step 8 Insert the bottom lip of the Whisper Cap behind the inner bottom edge of the filter retainer.

Step 9 Simultaneously press down on the top of the Whisper Cap and push in until the top lip of the Whisper Cap snaps into place behind the inner top edge of the filter retainer.

The filter should be in place at all times when the BiPAP unit is being used. A clean filter protects the patient from breathing irritating airborne particles.

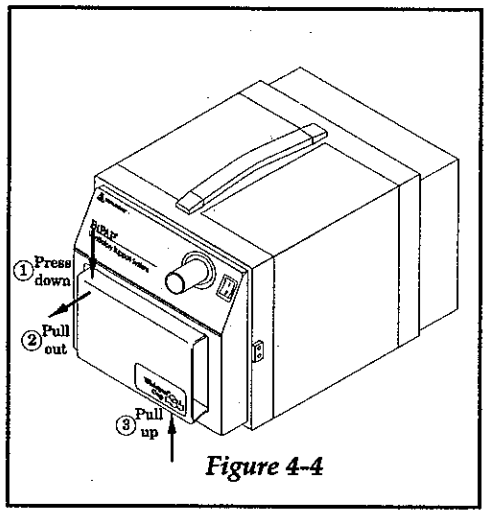


Figure 4-4

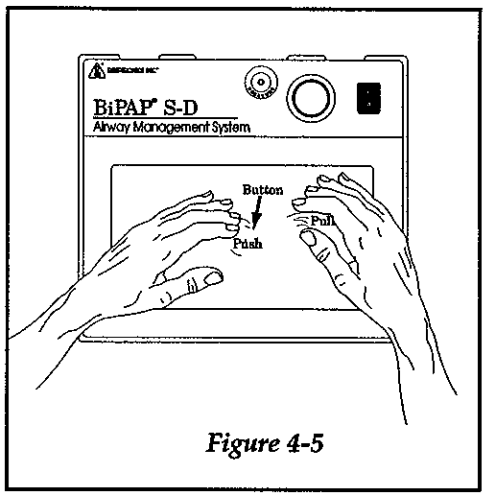


Figure 4-5

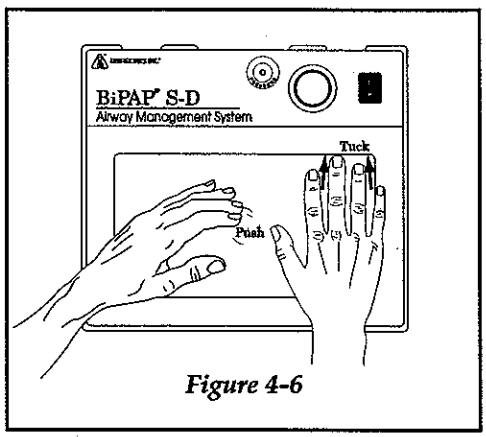


Figure 4-6

Chapter 5 Troubleshooting

5.1 Troubleshooting

5.2 Wiring Diagram

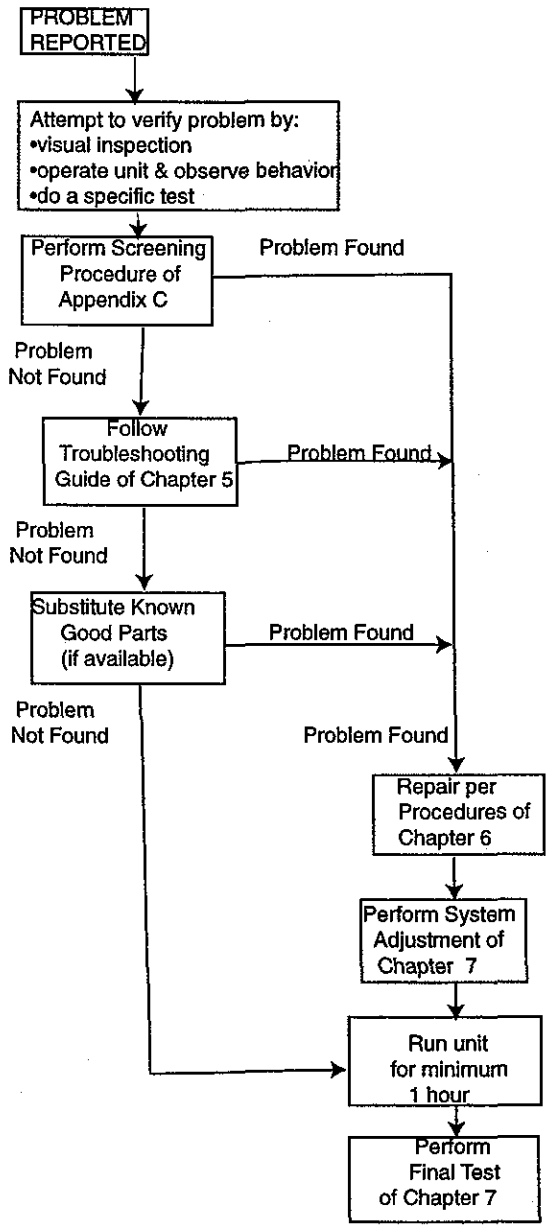
Chapter 5: Troubleshooting

5.1 Troubleshooting

WARNING: Electrical Shock Hazard: Disconnect the electrical supply before repairing the unit.

CAUTION: Electronic components used in this unit are subject to damage by static electricity. Use proper static discharge equipment and grounding precautions when servicing the equipment. Service only at a static-free workstation.

This section describes some unit problems that might occur, the possible causes, and the corrective actions that can be taken.


PROBLEM REPORTED
Attempt to verify problem by:
•visual inspection
•operate unit & observe behavior
•do a specific test
Perform Screening Procedure of Appendix C
Problem Found
Problem Not Found
Follow Troubleshooting Guide of Chapter 5
Problem Found
Problem Not Found
Substitute Known Good Parts (if available)
Problem Found
Problem Not Found
Problem Found
Repair per Procedures of Chapter 6
Perform System Adjustment of Chapter 7
Run unit for minimum 1 hour
Perform Final Test of Chapter 7

5.1.1 Troubleshooting Guide

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
The unit does not turn on.	The power cord is not securely attached to the unit or wall outlet.	Check that the power cord is plugged into the unit and into the wall outlet.
	The unit is not connected to a live outlet.	Check that the wall outlet has power. Check the circuit breaker.
	The unit fuse(s) is blown.	Replace fuse(s). See Section 4.2.3. If new fuses continue to blow out, follow Procedure 5.1.5, then Procedure 5.1.3 if necessary.
	Main power switch malfunction.	Remove the power cord from the wall outlet and the unit. With an ohmmeter, check between the top and bottom connections on each side of the switch. When the switch is "OFF," the connections should be open. When the switch is "ON," the connections should be closed (0 Ω).
	The fuse drawer is damaged or installed incorrectly.	Remove the fuse drawer from the AC Inlet. See Section 4.2.3. Inspect the drawer for damaged springs.
	The voltage selector switch is set to wrong voltage.	Verify the proper setting of the voltage selector switch on the back of the unit. If the unit is set at 230 V but plugged into a 115 V line, the unit will not operate. If the unit is set at 115 V but plugged into a 230 V line, the unit may operate intermittently.
	The motor wire is not securely plugged into the J1 position on the motor control board.	Check that the terminal is oriented properly and securely fastened to the board pins.
	Faulty transformer.	Follow Procedure 5.1.5.

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
The unit does not turn on. (Continued)	Faulty jumper wires on the primary side of the transformer.	Check the continuity of the jumper wires between transformer terminals T1-T3 and between T4-T5. Replace the jumpers if necessary.
	Faulty wiring; overcrimped or broken terminals.	Follow Procedure 5.1.2.
	Motor control board (MCB) is malfunctioning.	Follow Procedure 5.1.3.
The unit starts and stops.	Loose power cord connection at the unit or the wall outlet.	Check that the power cord connections (at the unit and at the wall) are firmly in place.
	Intermittent connection at the main power switch.	Follow Procedure 5.1.2.
	Blower overheating.	Replace the blower assembly. See Section 6.2.2.
	The voltage selector switch is set to wrong voltage.	Verify the proper setting of the voltage selector switch on the back of the unit. If the unit is set at 230 V but plugged into a 115 V line, the unit will not operate. If the unit is set at 115 V but plugged into a 230 V line, the unit may operate intermittently.
Incorrect pressure when checked with a water column or digital manometer. **NOTE:** Pressure readings may deviate ±2 cm H_2O from specified levels.	Blower malfunctioning.	If the blower displays any vibration or rumbling noise, replace the blower assembly. See Section 6.2.2.
	Motor control board (MCB) malfunctioning.	Follow Procedure 5.1.3.
	A leak in the system.	Visually inspect the flex connector, bellows, and pressure tubing for cracks or splits. Inspect the hose clamps and nylon tie wraps. Inspect the bellows or tubing under the clamps. Check that all fittings are tight and that the mask is not leaking.

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Incorrect pressure when checked with a water column or digital manometer. (Continued)	The blower or the pressure controller is malfunctioning.	Perform the calibration (see Chapter 7) without making any adjustments to the trimpots, and record the data. Compare the test data with the specifications; if the unit does not meet the specs, perform the full calibration and readjust the trimpots where needed. If the unit fails, then replace the part indicated by the test.
No difference between IPAP and EPAP pressures. **NOTE:** Pressure readings may deviate ±2 cm H_2O from specified levels.	Improper control settings.	Adjust the control settings. Recheck with a manometer.
	Defective valve.	Follow Procedure 5.1.6.
	Blown crowbar fuse on Bipap Control Board.	Remove the fuse and check the continuity. Replace fuse if necessary.
	Defective Bipap Control Board.	Follow Procedure 5.1.7.
Pressure fluctuations during IPAP or EPAP modes.	Defective blower assembly.	Follow Procedure 5.1.8.
	Defective motor control board.	Follow Procedure 5.1.3.
	Defective Bipap Control Board.	Perform the calibration (see Chapter 7). If the unit cannot be adjusted to meet specs, replace the control board.
Low flow and/or pressure.	Defective valve.	Follow Procedure 5.1.6.
	Defective Bipap Control Board.	Follow Procedure 5.1.7.
	Defective blower assembly.	Follow Procedure 5.1.8.
	Filter dirty or clogged.	Replace the intake filter. See Section 4.2.7.

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Low flow and/or pressure. (Continued)	Leak in system.	Visually inspect the flex connector, bellows, and pressure tubing for cracks or splits. Inspect the hose clamps and nylon tie wraps. Inspect the bellows or tubing under the clamps. Check that all fittings, both internal and external, are tight and that the mask is not leaking.
Unit operates "warm."	The filter has become obstructed or dirty.	Replace the filter. See Section 4.2.7.
	Defective blower.	Check the motor balance. If it is out of balance, replace the blower assembly as described in Section 6.2.2.
	Defective motor control board.	Follow Procedure 5.1.3.
	Leak in system.	Visually inspect the flex connector, bellows, and pressure tubing for cracks or splits. Inspect the hose clamps and nylon tie wraps. Inspect the bellows or tubing under the clamps. Check that all fittings, both internal and external, are tight and that the mask is not leaking.
Excessive noise or chattering.	Loose wraparound fit.	Replace the wraparound. See Section 6.2.1.
	The unit is operating without a filter—the plenum rattles.	Install a filter. See Section 4.2.5.
	The wiring harness vibrates against the blower assembly.	Manipulate the wiring assembly away from the blower assembly.
	The blower assembly is damaged.	Replace the blower assembly. See Section 6.2.2.

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Excessive noise or chattering. (continued)	The blower pressure is excessively high.	Perform the Calibration and Calibration Checks(see Chapter 7) without making any adjustments to the trimpots; record the data. Compare the test data with the specifications. If the unit does not meet the specs, perform the System Set-up and Final Test and readjust the motor speed as needed.
	Whisper Cap is missing.	Replace Whisper Cap.
The time meter is not functioning.	Motor control board malfunctioning.	Measure the voltage at the motor control board connector J2, between pins 9 and 10, with pin 9 as ground. The voltage should be +5 VDC ±0.5 V. If no voltage is measured, replace the motor control board. See Section 6.2.3.
	Time meter malfunctioning.	Measure the voltage between J2-9 and J2-10 as described above. If 5 VDC ±0.5 V is measured, replace the time meter. See Section 6.2.16.
The unit "breathes" on its own. IPAP/EPAP lights flicker erratically.	The pressure transducer tubing is disconnected.	Check the integrity of the tubing from the flow transducer to the Bipap Control Board. Reconnect the tubing if necessary.
	The tubing is routed incorrectly.	Check the routing of the tubing from the flow transducer to the Bipap Control Board for proper orientation.
The DCP does not work with the unit.	Faulty DCP.	Try a new DCP with the unit.
	Faulty DCP cable.	Perform a continuity check on the cable or substitute with a known good cable.
	Bipap Control Board (BCB) malfunction.	Check the DCP terminals. Replace the control board. See Section 6.2.4.
Unit does not trigger is S/T Mode.	Faulty BCB.	Change BCB. See Section 6.2.4.

5.1.2 Power Switch Wiring

Step 1 Turn the unit off, disconnect the power cord from the wall and the unit, and remove the wraparound (see 6.2.1).

Step 2 Check the continuity of the wires from the switch to the primary side of the transformer. The top white wire on the switch is connected to transformer terminal T3. The top red wire on the switch is connected to transformer terminal T4.

If either wire shows an open circuit, it may indicate a more serious problem. Return the unit to Respironics.

5.1.3 Motor Control Board (MCB) Checks

NOTE: The following voltage measurements were made on a new unit set to the IPAP mode. The outlet circuit consisted of the hose with a 0.250 inch orifice on the outlet end. The pressure was set to 10 cm H_2O, measured with a digital manometer. The input voltage was 110 VAC.

Step 1 Turn the unit off, disconnect the power cord from the wall and the unit, and remove the wraparound (see 6.2.1).

Step 2 Connect a DC voltmeter negative lead to J2 pin 6. Connect the positive lead to J2 pin 5. Reconnect the power cord and turn the unit on; the voltmeter should read +14 to +18 VDC.

Step 3 Connect a DC voltmeter negative lead to J2 pin 6. Connect the positive lead to J2 pin 7. The voltage should be -14 to 18 VDC.

Step 4 Place the negative lead on J1 pin 2 (ground). Re-connect the power cord and turn the unit on. The following voltages should be present with respect to ground:

J1 pin 1:	6.25 VDC ±0.5 VDC	
J1 pin 3:	3 VDC	These voltages should be uniform, with a variation of less than ±0.5 VDC.
J1 pin 4:	3 VDC	
J1 pin 5:	3 VDC	
J1 pin 6:	7 VDC	These voltages should be uniform, with a variation of less than ±0.5 VDC.
J1 pin 7:	7 VDC	
J1 pin 8:	7 VDC	

The voltages measured on pins 4 through 8 represent the DC component of a complex AC waveform. The voltages may vary depending on the age of the unit, condition of the blower, etc. The main requirement of the measurements is that the voltages on pins 3, 4, and 6 are within 0.5 VDC, and the voltages on pins 6, 7, and 8 are within 1.0 VDC. If the voltages on pins 1,3,4, and 5 deviate beyond ±0.5 VDC, or if the voltages on pins 6 to 8 do not match each other, replace the MCB. See Section 6.2.3.

NOTE: The position of pin J1-1 is as marked on the board, and connects to the yellow wire from the blower. Disregard any numbers molded on the wire connector on the wires from the blower.

5.1.4 Blower Assembly Checks

Step 1 Turn the unit off, disconnect the power cord from the wall and the unit, and remove the wrap-around (See Section 6.1.1).

Step 2 Disconnect all leads from terminal J1 on the Motor Control Board.

Step 3 Use the table below to verify resistances between the blower assembly connector leads.

NOTE: The position of pin J1-1 is as marked on the board, and connects to the yellow wire coming from the blower. Disregard any numbers molded on the wire connector on the wires coming from the blower.

Pin	1	2	3	4	5	6	7	8
1		4M	D16M	D16M	D16M	∞	∞	∞
2	4M		D4M	D4M	D4M	∞	∞	∞
3	D16M	D4M		∞	∞	∞	∞	∞
4	D16M	D4M	∞		∞	∞	∞	∞
5	D16M	D4M	∞	∞		∞	∞	∞
6	∞	∞	∞	∞	∞		1	1
7	∞	∞	∞	∞	∞	1		1
8	∞	∞	∞	∞	∞	1	1	

The table indicates the correct readings. "4M" indicates 4 ±1.5 MΩ. "∞" indicates infinite resistance (an open circuit). "1" means less than 1 Ω. "D" means that the resistance changes depending upon placement of the "+" and "-" leads due to the diode effect. In one direction, you should measure an open. In the other direction you should measure 16 ±6 MΩ, for older units or 11±3 MΩ where the table indicates "D16M," and 4 ± 1.5MΩ where the table indicates "D4.M"

If these resistance readings are incorrect, change the blower assembly. See Section 6.2.2.

5.1.5 Transformer Checks

Step 1 Turn the unit off, disconnect the power cord from the wall and the unit, and remove the AC inlet fuses (see Section 4.2.3).

Step 2 Remove the wraparound as shown in Section 6.2.1, Steps 1 to 4.

Step 3 Connect an ohmmeter across transformer terminals T5 and T6. The resistance should be 10.6 Ω ± 10% when the voltage selector switch is set to 230 V, and should be approximately 5.3 Ω ± 10% when the voltage selector switch is set to 115 V.

Step 4 Repeat Step 3 with the ohmmeter across transformer terminals T1 and T2.

If the resistance readings are not correct, replace the transformer sub-assembly. See Section 6.2.5.

5.1.6 Valve Checks

Step 1 Turn the unit off, disconnect the power cord from the wall and the unit, and remove the wrap-around (see 6.2.1).

Step 2 Check the integrity and orientation of the J1 connector on the Bipap BCB.

Step 3 Connect a DC voltmeter from J1-1 (ground) to J1-2.

Step 4 Reconnect the power cord and turn the unit on.

If the voltmeter measures 0.0 VDC, replace the valve. See 6.2.7.

5.1.7 BiPAP Control Board (BCB) Checks

Step 1 Turn the unit off, disconnect the power cord from the wall and the unit, and remove the wrap-around as described in 6.2.1.

Step 2 Check the integrity and orientation of the J1 connector on the BCB.

Step 3 Connect a DC voltmeter from J1-1 (ground) to J1-2.

Step 4 Reconnect the power cord and turn the unit on.

If the voltmeter measures greater than 5.0 VDC, replace the BCB. See 6.2.4.

5.1.8 Blower Pressure Check

Step 1 Turn the unit off, disconnect the power cord from the wall and the unit, and remove the wrap-around as described in 6.2.1.

Step 2 Reconnect the power cord to the unit and the wall. Monitor the pressure at the outlet with a manometer.

Step 3 Turn the unit on and hold the valve shut. If the outlet pressure is not steady, replace the blower assembly as described in 6.2.2.

5.1.9 Temperature Guidelines

Use this procedure when troubleshooting a complaint that the unit is running hot: either the unit feels hot to the touch, or the air is hot on the face. Like any electrical appliance, heat is emitted when a BiPAP unit runs. Also, for some units,the higher the pressure setting, the more electrical energy is required; therefore, there is more heat expelled.

It is normal for the pre-foam BiPAP unit to have an outlet air temperature that is 10 to 12 °F warmer than room temperature, especially after running all night. A difference between room temperature and air outlet temperature greater than 18 °F is an indication for a service check. Foamed units (serial number 052000 or greater) can be expected to have an outlet air temperature that is 18 to 25 °F warmer than room temperature, especially after running all night. A difference between room temperature and air outlet temperature greater than 25 °F is an indication for a service check on a foamed BiPAP unit. The air temperature at the end of a patient circuit will always be lower than the temperature measured at the outlet and is typically 5 to 10 °F above ambient.

To test a unit, run the unit at the patient's prescription setting. It is recommended to run the unit overnight. Measure the room temperature near the center of the unit's inlet filter. Measure the temperature of the air at the outlet of the unit. A thermometer may be mounted in a standard Respironics test adaptor.

Some normal causes of elevated temperatures are:

- The room temperature or humidity has risen.
- The air inlet filter has become obstructed.
- The air filter has become dirty.
- The patient's condition has changed (e.g., running a fever).
- The unit is malfunctioning.

5.2 Wiring Diagram

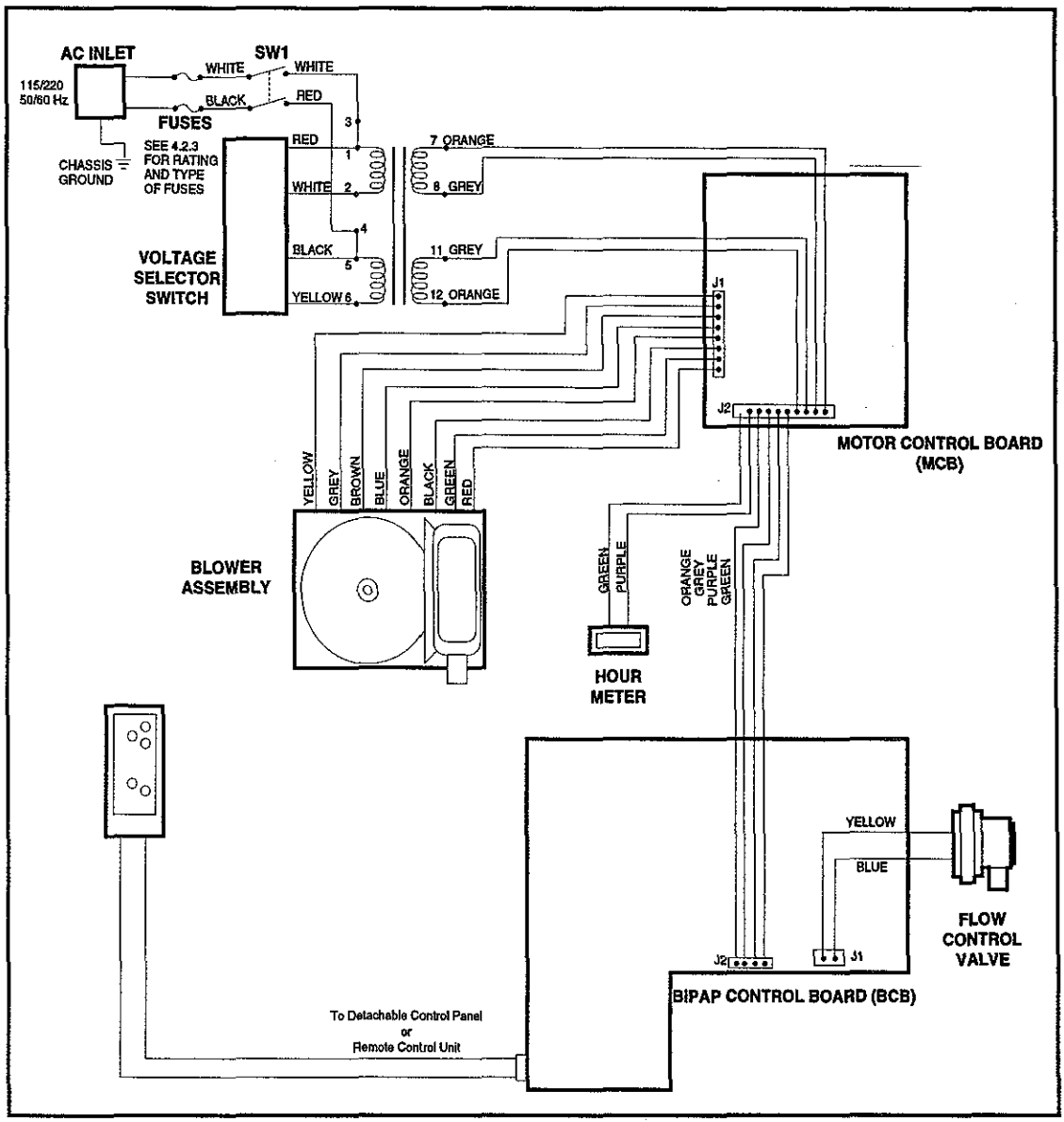


Figure 5-1

NOTE: Do not connect the DCP port to any other type of electronic equipment, computer interface, etc. Damage to the system may result.

Chapter 6 Repair and Replacement

6.1 Repair Information

6.2 Replacement Guide

6.1 Repair Information

WARNING: All repairs must be accomplished in a manner that maintains traceability of the components assembled in each unit. All replacement parts must be identified by Part Number and Lot Number, and a record of the repair must be forwarded to Respironics at the following address:

1001 Murry Ridge Drive
Murrysville, PA 15668-8550
Main Office: 412/733-0200 • Toll Free: 800-638-8208 • Fax: 412/733-0299

WARNING: Adjust the unit as outlined Chapter 7 if any repairs are made that replace major subassemblies (such as the blower, valve, circuit boards) or which affect the air stream integrity (such as the muffler or flow tubes).

WARNING: Electrical shock hazard. Disconnect the electrical supply before making repairs to the BiPAP 20 unit.

CAUTION: Electronic components used in this unit are subject to damage by static electricity. Use proper static discharge and grounding precautions when servicing the equipment. Service only at a static-free workstation.

CAUTION: Units with serial numbers less than 1724 must be returned to the factory for repairs. DO NOT attempt to repair these units.

NOTE: Use Loctite® small screw thread locker 222 (Purple Dot) for small screws where designated.

NOTE: If you require technical assistance during any of these replacement procedures, call,

Respironics Technical Service Department
Phone: 1-800-722-4271 (US and Canada) or 412-733-0200
FAX: 1-800-422-5816 (US and Canada) or 412-733-0299

If you need replacement kit information, call:

Respironics Customer Satisfaction Department
Phone: 1-800-345-6443 (US and Canada) or 421-733-0200
FAX: 1-800-886-0245 (US and Canada) or 412-733-0299

NOTE: Visit Respironics' Home page on the World Wide Web
http: //www.respironics.com

6.1.1 Preparing the Unit for Service

Tools Required:

#2 Phillips screwdriver

Refer to Figure: 6-1

Procedure:

Step 1 Make sure that the work area is clean and static free.

Step 2 Remove the patient circuit from the unit. Remove the DCP and the pressure port hose (S/T-D and S-D units only).

Step 3 Unplug the unit from the wall outlet and disconnect the electrical plug from the back of the unit.

Step 4 Remove the wraparound as follows:

a. Tip the unit so that it rests on the rear end cap.

b. Remove the four screws on the bottom of unit. The screws attach the feet (A) to the wrap-around (B) and the wraparound to the unit frame.

c. Tip the unit upright. Push down on the edges of the wraparound (B) until it is free. Pull the unit up out of the wraparound.

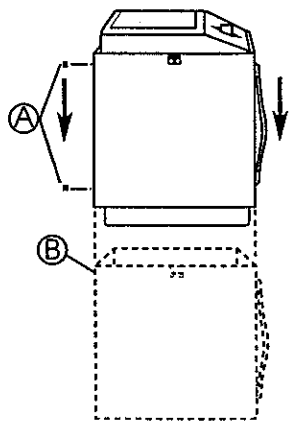


Figure 6-1

6.1.2 Releasing Cable Clips

Figure 6-2 shows how to release cable clips. Insert a slotted screwdriver between the upper and lower tabs. Twist the screwdriver to push down on the lower tab and up on the upper tab.

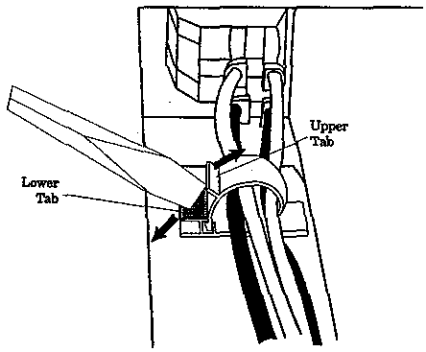


Figure 6-2

6.1.3 Releasing Hose Clamps

Figure 6-3 shows the process to release the hose clamps that hold the bellows and flex connector to their respective ports. Insert a slotted screwdriver where indicated and twist to release the ratchets; pull the hose clamp apart. Normally, the replacement kit contains new hose clamps if the old ones are removed.

NOTE: Disconnecting the bellows could change the leak characteristics and the System adjustment and Final Test in Chapter 7 of this manual must be repeated.

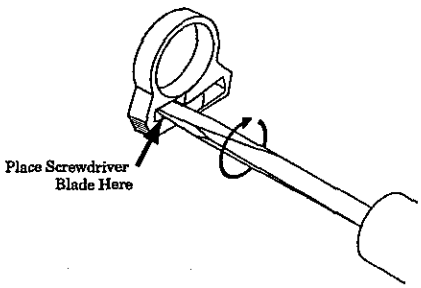


Figure 6-3

6.2 Replacement Guide

6.2.1 Wraparound Replacement

Repair Kit Number: **332183 for all S and all S/T units**
332183 for S-D and S/T-D, S/N > 30000
332345 for S-D and S/T-D, S/N < 30000

Repair Kit Contents	Tools Required
BiPAP Wraparound (1) Screw-on feet (4)	Torque screwdriver set to 4 in-lb

Refer to Figure: 6-1

Procedure:

Step 1 Remove the wraparound assembly as described in Section 6.1.1.

Step 2 Install the new wraparound and insert the four new screw-on feet in the unit bottom.

NOTE: For S-D and S/T-D models with serial numbers less than 30000, you must replace the wraparound with Replacement Kit number 332345. The wraparound is an EMI-shielded wraparound. For units with serial numbers greater than 30000, a new multi-layered board eliminates the need for the new wraparound. These models will use Replacement Kit number 332183.

Acceptable Combinations:

	Old Wraparound	New Wraparound
BiPAP S-D, S/T-D, S/N <30000	Replace with new wraparound	OK
BiPAP S-D, S/T-D, S/N >30000	OK	OK

NOTE: The old 332183 wraparound has a ¾" square molded in the bottom. The new 332345 wraparound has both the ¾" square and a ⅝" circle inside the square.

6.2.2 Blower Assembly Replacement

Repair Kit Number: 332181

Repair Kit Contents	Tools Required
Blower module S/A (1) Tie wraps, ET-7 (4) Cable clip (1) Tie wrap, ET-3 (1) Hose clamps (2) 8-position PC male mount conn. (1) Nylon standoffs (2) 0.1 µf capacitor (1)	Needle nose pliers Cutting pliers Manual Nut Driver set at 4 in-lb Torque Nut Driver set capable of 4 in-lb and 10 in-lb

Refer to Figures: 6-4, 6-5, 6-6

NOTE: If a new blower has ben installed in a unit with an old BCB which has R91, you may not be able to perform the flow calibration; the board, in about 10% of the cases, does not have enough gain. If this occurs, Respironics recommends that you install a new board to ensure the successful calibration of the transducer, but you may try another old board.

NOTE: The blower assembly (A) includes the blower impeller and motor. The unit must be replaced as an assembly.

Disassembly:

Step 1 Remove the wraparound as described in Section 6.1.1, Preparing the Unit for Service.

NOTE: For BiPAP units with Serial Numbers greater than 52000, substitute Steps 2 to 5 in Section 6.2.21 for Step 2.

Step 2 With the torque screwdriver, remove the four Phillips head screws holding the two end cap cross bars (B) to the front (C) and rear (D) end caps. Rotate the cross bars slightly and lift them up and out of the unit.

CAUTION: The system tubing is held tightly on the connectors. Do not pull the tubes from side to side; use a straight, firm pull to break the seal. Label the tubes for proper reconnection.

Step 3 Disconnect the flow pick-up tubes (E) from the top of the blower assembly.

Step 4 Turn the unit upside down.

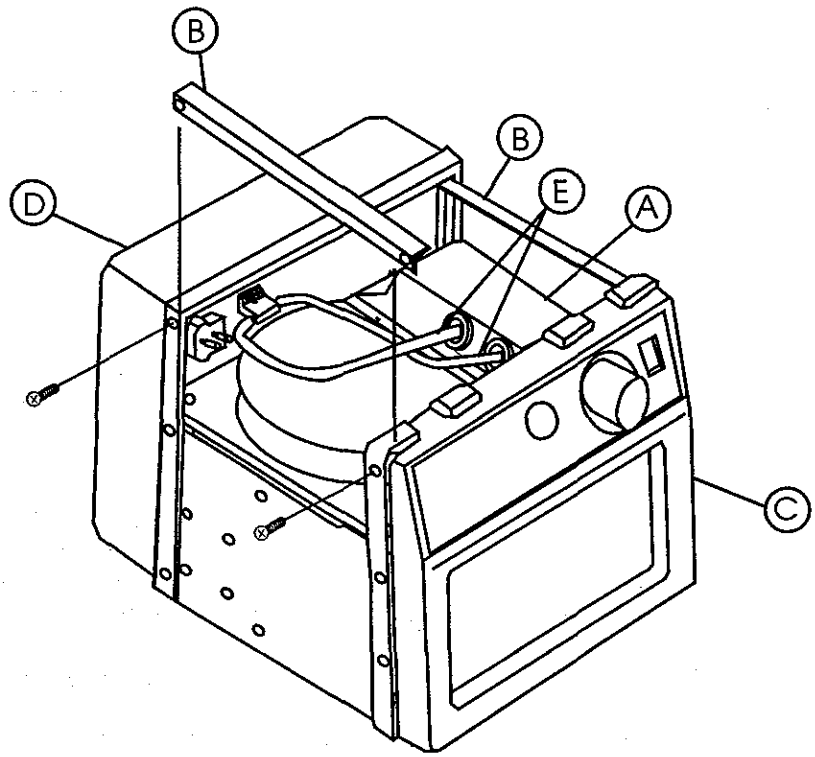


Figure 6-4

NOTE: For BiPAP units with serial numbers greater than 52000, perform Steps 3 to 4 of Section 6.2.22 before proceeding to Step 5.

CAUTION: Before disconnecting the blower wire plug (F) from the Motor Controller Board (MCB) (G), note the proper orientation of the plug and label it for reconnection.

Pull the plug gently away from the MCB to prevent damage to the wires.

Step 5 Disconnect the blower wire plug (F) from the MCB (G). The plug is a white 8-pin connector. With a slotted screwdriver, open the wire retaining clip on the bottom of the blower cover and remove the wires from the clip.

NOTE: The hose clamps ratchet together. Use a slotted screwdriver to open the clamps.

Step 6 Remove the tube clamp on the blower inlet port (H) and discard the clamp. Carefully slide the bellows away from the blower inlet port.

Step 7 Remove the four remaining Phillips screws (I) that attach the front end cap to the chassis.

NOTE: For BiPAP units with serial numbers greater than 52000, these screws were removed prior to Step 2.

Step 8 Turn the unit right-side up.

Step 9 Remove the tube clamp on the blower exit port (J) and discard the clamp. Slide the flexible connector off of the exit port.

Step 10 Open the wire retaining clips on the outside of the blower housing, remove the wire bundles from the clip, and move the wires away from the blower housing.

Step 11 Place the unit on its side with the transducer side of the blower facing up. Move the end cap out of the way.

Step 12 Using a torque nut driver set to 10 in-lb, remove the four nuts (K) holding the blower assembly to the rubber shock mounts (L).

NOTE: For units with serial numbers greater than 80691, there is no bellows on the muffler connection.

Step 13 Slowly pull the transducer side of the blower assembly until you expose the tie wraps retaining the valve and muffler bellows. Cut and discard the tie wraps (M—two are used on each bellows), being careful not to cut the bellows. Side cutters are recommended for cutting the wraps.

NOTE: If a valve coupling(O) is used between the blower and valve then pull to remove it.

Step 14 Remove the blower assembly from the BiPAP chassis.

Step 15 Examine the replacement blower: verify that all screws securing the two parts of the blower assembly are in place and tight.

Step 16 Remove the protective tape cover from the wire retaining clip in the replacement kit. Secure the clip on the blower cover bottom in approximately the same position and orientation as on the original blower assembly.

NOTE: Valve/Muffler is shown detached for clarity only.
You will not remove the Valve or Muffler for Blower Assembly Replacement.

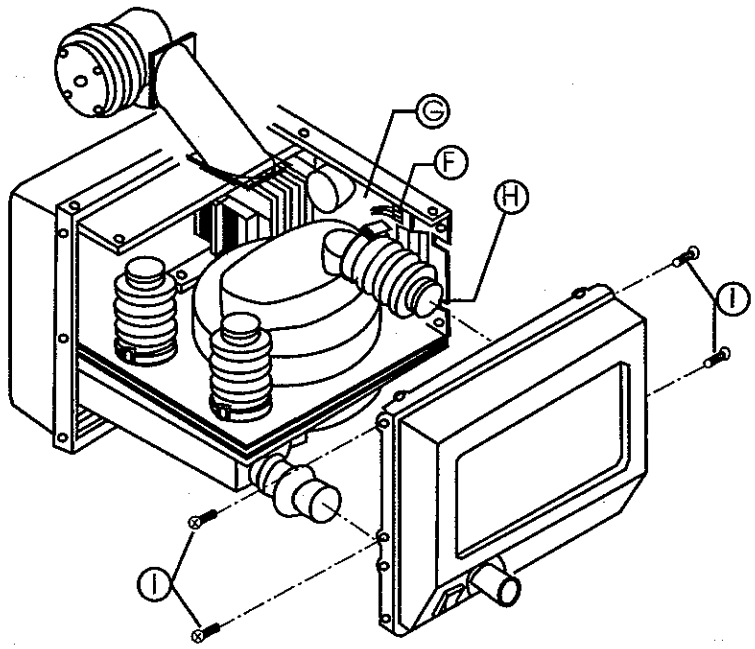


Figure 6-5

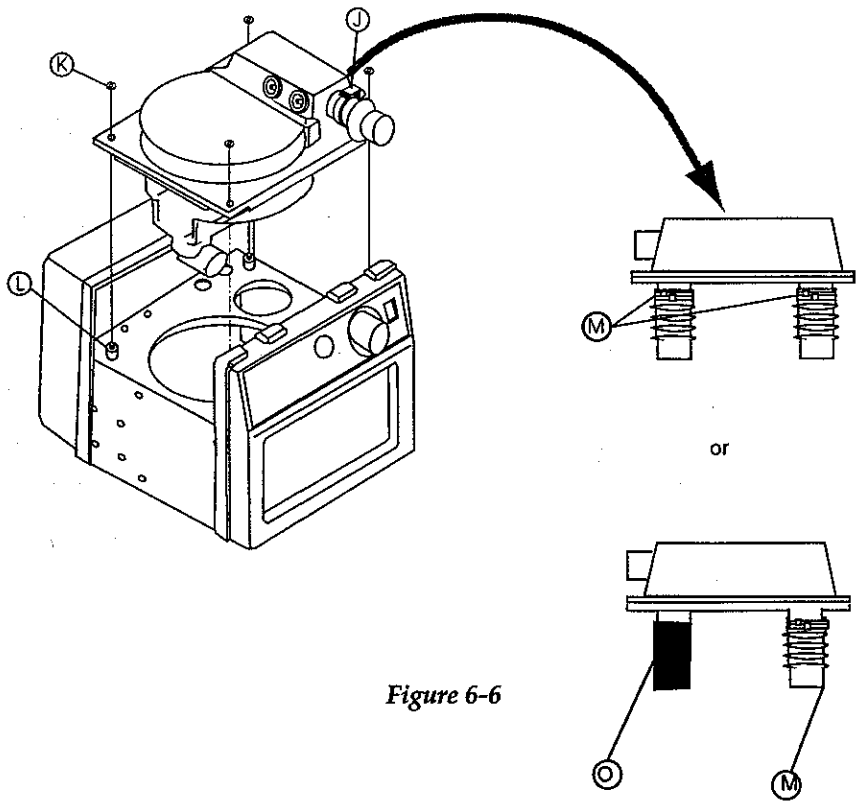


Figure 6-6

NOTE: Some older boards have a 0.1 µf capacitor located on the trace side of the MCB, soldered between pins 1 and 2 of the header connector (J1). If the board you are working on has this capacitor, discard it when you remove the old header and replace it with the new one included in the kit. If this capacitor does not exist on the MCB under repair, discard the capacitor which is included in the kit.

CAUTION: The replacement blower motor connector is gold-plated. The 8-position PC mount connector (J1) on the Motor Control Board (MCB) must also be gold-plated. Inspect J1 on your MCB: if it is not gold-plated, you must replace it with the PC mount connector supplied in this kit. To remove and replace the board, follow the procedures of Section 6.2.3 to remove and replace the board. This kit contains two nylon standoffs if you need to replace the standoffs on the board.

Reassembly:

NOTE: For units with serial numbers greater than 80691, the muffler does not require a bellows. The blower port inserts directly into the muffler.

NOTE: Any unit can accept a coupling beween the blower and the valve instead of the bellows. When installing a coupling between the valve and blower, hose clamps and tie-wraps are not required. Apply a light mist of alcohol on the valve and muffler blower port when installing the coupling.

Step 1 Apply a light mist of alcohol on the valve and muffler blower ports. Gently lower the new blower assembly onto the rubber shock mounts, making sure the valve and muffler bellows fit over the blower ports. Install two tie wraps on each bellows.

NOTE: To install the tie wraps on the valve and muffler bellows, start to make the loop in one of the tie wraps, and place it on the bellows. After the bellows is in place, tighten the tie wrap with a tie wrap gun. Assemble the second tie wrap around the bellows and tighten. Be sure the tie wraps are on the portion of the bellows that overlaps the blower port. Repeat for the other bellows. The knuckles of the two tie wraps should be at least 90° apart.

Step 2 Replace the four nuts onto the shock mounts and tighten with the torque nut driver set to 10 in-lb.

Step 3 Place the front end cap at the front of the chassis.

Step 4 Apply a light mist of alcohol on the blower exit port and slip the flexible connector over the port. Secure the connector with a tubing clamp.

Step 5 Reconnect the flow pick-up tubes to the flow transducer ports. Push the tubes all the way onto the ports.

Step 6 Turn the unit upside down.

CAUTION: Be sure to replace the wire plug in its proper orientation.

Step 7 Route the system wiring through the wire retaining clip on the bottom of the blower assembly and reconnect the blower wire plug to the MCB. Close the retaining clip.

Step 8 Apply a light mist of alcohol on the blower intake port and slip the intake bellows over the port.

Secure the bellows woht a tubing clamp.

NOTE: For BiPAP units with serial numbers greater than 52000, do not perform Step 9.

Step 9 Use the torque screwdriver to replace and tighten the four Phillips screws that attach the front end cap to the chassis.

NOTE: For BiPAP units with serial numbers greater than 52000, perform the Reassembly Steps 1 to 3 of Section 6.2.22 before proceeding to Step 10.

Step 10 Turn the unit right side up.

NOTE: For BiPAP units with serial numbers greater than 52000, substitute reassembly steps 1 to 5 of Section 6.2.21 for Step 11.

Step 11 Replace the cross bars.

Step 12 Replace the wraparound and rubber feet.

Step 13 Perform the System Adjustment and Final Test procedures in Chapter 7 of this manual.

6.2.3 Motor Controller Board (MCB) Replacement

Replacement Kit Number: 332172 for serial numbers less than 200,000
332553 for serial numbers 200,000 or greater

CAUTION: The electronic components used in the MCB are subject to damage by static electricity. Use the proper static discharge and grounding precautions when servicing the equipment. Service only at a static-free work station.

CAUTION: The appropriate Replacement Kit must be used for repairs based on the serial number of the unit. The changes that occurred to the unit can be found in Appendix F of this manual.

Repair Kit Contents	Tools Required
Motor controller board (1) Tie wraps, ET-7 (4) Nylon standoffs (2) Tie wrap, ET-3 (1) 6 x 1/4" screws (2) 8-position PC cable mount female (1)	Needle nose pliers Cutting pliers Torque screw driver capable of 4 in-lb and 10 in-lb AMP connector tool-head #58246-1

Refer to Figures: 6-7

Disassembly:

Step 1 Remove the blower assembly as described in Section 6.2.2, Blower Assembly Replacement.

Step 2 Turn the unit upside down.

CAUTION: Be sure to note the proper position and orientation of the plugs. Label the plugs to ensure proper reconnection.

Step 3 Remove all of the wire plugs from the MCB.

Step 4 Use the torque screwdriver to remove the two machine screws and nuts (B) holding the MCB to the frame (C).

Step 5 The MCB is mounted on its left side on two nylon standoffs (D). Hold the standoffs with a pair of needle-nosed pliers and remove the screws from the outside of the chassis. New standoffs and screws are provided in the kit.

CAUTION: The header connector (J1) on the replacement MCB is gold-plated. The motor connector on the blower must also be gold-plated. Inspect the blower connector on your blower: if it is not gold-plated, you must replace it with the connector supplied in this kit. To remove and replace the blower, follow the procedures of Section 6.2.2.

Reassembly:

Step 1 Insert the new standoffs from the rear of the MCB. Align the standoff holes with the appropriate chassis holes and insert the two 6 x ¼" screws. Tighten with the torque screwdriver set to 4 in-lb.

CAUTION: For proper heat sinking of the board components, the nuts holding the heat sink (E) to the unit frame must be tightened securely.

Step 2 Insert the two Phillips head machine screws through the unit frame and through the MCB mounting holes. Replace the hex head nuts. Tighten with the torque screwdriver set to 10 in-lb.

Step 3 Connect the wire plugs to the new board, being careful to connect the plugs in the same position and orientation as on the original board. If there is any doubt about the wiring connections, refer to Figure 5-1, System Wiring Diagram.

Step 4 Replace the blower assembly as described in Section 6.2.2, Blower Assembly Replacement.

NOTE: For units with serial numbers less than 52000, substitute Reassembly Steps 1-5 of Section 6.2.21 for Step 5.

Step 5 Replace the cross bars.

Step 6 Replace the wraparound and feet.

Step 7 Perform the System Adjustment and Final Test procedures in Chapter 7 of this manual.

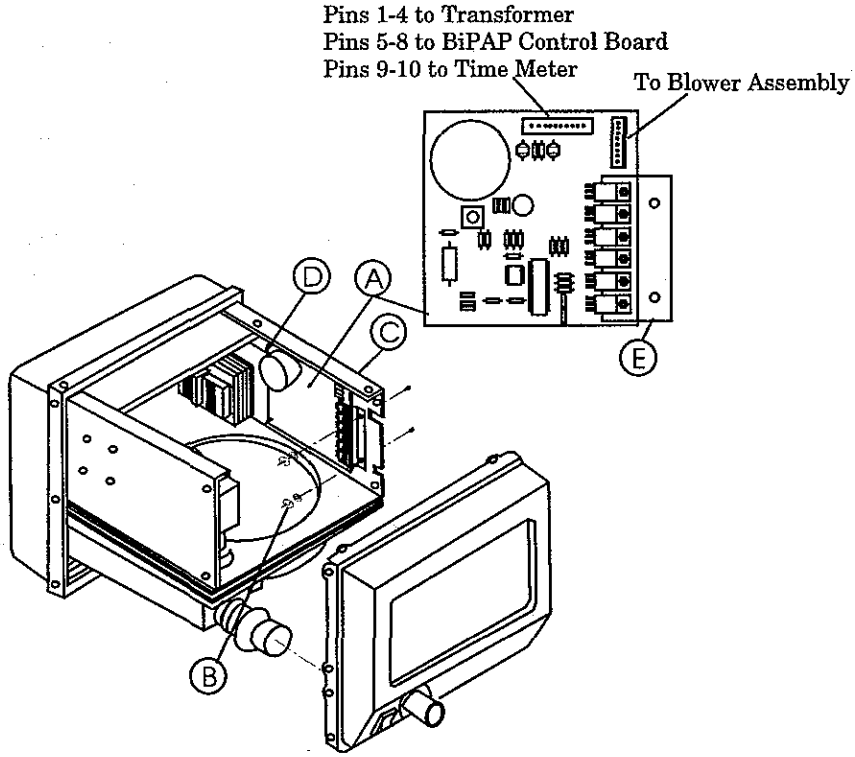


Figure 6-7

6.2.4 BiPAP Control Board (BCB) Replacement

Replacement Kit Number: S= 332168; S/T= 332169; S/T-D= 332170; S-D= 332171

CAUTION: The electronic components used in the BCB are subject to damage by static electricity. Use the proper static discharge and grounding precautions when servicing the equipment. Service only at a static-free work station.

Repair Kit Contents	Tools Required
BiPAP controller board (1) Tie wraps, ET-3 (3) 6-32 latch-type fasteners (2)	Needle nose pliers Cutting pliers Torque screw driver capable of 4 in-lb and 6 in-lb Torque nut driver capable of 4 and 6 in-lb Manual screwdriver set to 6 in-lb

Refer to Figures: 6-8, 6-9

Disassembly:

Step 1 Remove the wraparound as described in Section 6.1.1, Preparing the Unit for Service.

Step 2 Open the control panel door and remove the control knobs (A). For older units, use a 0.050" Allen Wrench to loosen the set screws (B) holding the control knobs to the potentiometers. For newer units, pull the knobs off the potentiometer shafts. Remove the knobs and note which knob is used on which potentiometer.

Step 3 Use a 4 in-lb torque nut driver to remove the hex nuts (C) from the potentiometers. The function selector pot has a ⅜" nut; the rest of the control pots have 5/16" nuts.

Step 4 **S-D and S/T-D units only** — Use the 6 in-lb manual screwdriver to remove the two screws (D) from the DCP cable connector.

NOTE: For units with serial numbers greater than 52000, perform Steps 2-4 of Section 6.2.20 before Step 5.

Step 5 Cut the nylon ET-3 wire ties from the flow pick-up tubes (E) at the BCB ports. Discard the wire ties. Label the tubes to ensure proper replacement, then remove them from the ports. **For S-D and S/T-D units only** — Cut the nylon wire tie from the tube at the pressure transducer (F); discard the wire tie; and remove the pressure port tube.

Step 6 With the torque screwdriver set to 6 in-lb, remove the six Phillips head screws (G) holding the rear end cap (H) in place. Note that two of the six screws retain the cross bar.

Step 7 Move the end cap away from the unit. The wires to the power connector, voltage selector switch, elapsed time indicator, and DCP cable connector will limit the distance you can move the endcap.

Step 8 Remove the three connectors on the BCB: The valve connector (I) which consists of two wires; the motor control board connector (J) which consists of four wires; and the ground wire (K). Be sure to note the location and orientation of the connectors; label them if necessary. The ground wire is removed by removing the flat head screw and nylon washer.

Step 9 Remove the six flat head screws (L) with nylon washers that hold the BCB to the end cap.

Step 10 Remove the BCB from the unit.

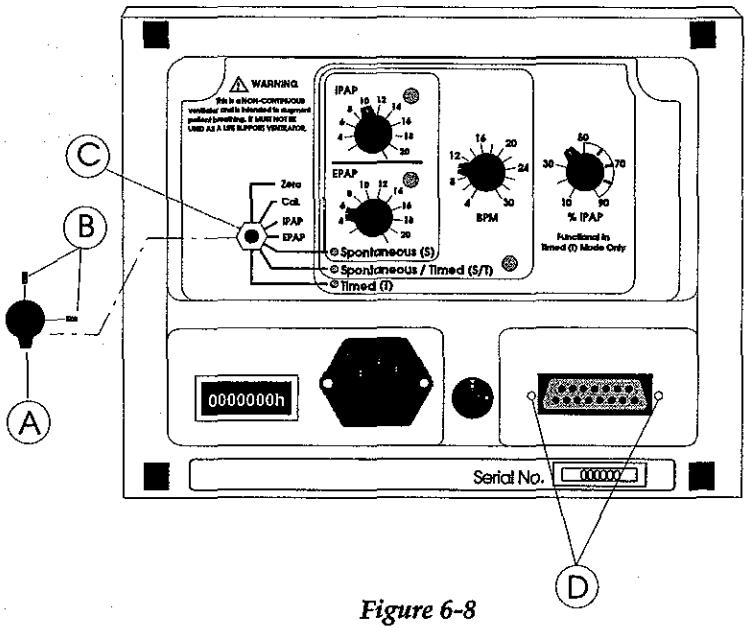


Figure 6-8

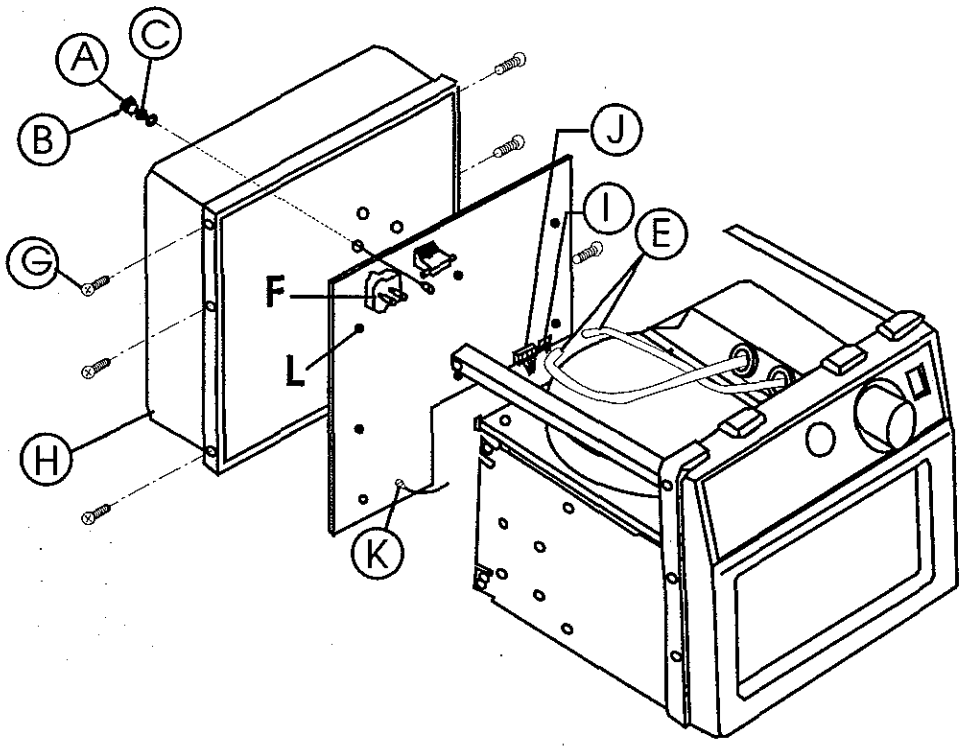


Figure 6-9

Reassembly:

CAUTION: Be certain that the nylon washers are in place before you tighten the screws.

Step 1 Place the new BCB on the end cap, aligning the six holes in the board with the six threaded mounts in the end cap. Insert the six flat head screws and tighten them with the torque screwdriver set to 6 in-lb.

Step 2 Connect the ground wire, the motor control board connector, and the valve connector to the BCB. Make certain that the nylon washer is positioned between the ground connector and the board.

Step 3 Slide the end cap back into position, aligning the six screw holes. Insert the six Phillips head screws and tighten them with the torque screwdriver set to 6 in-lb.

Step 4 **For S-D and S/T-D units —** replace the two flat head screws that secure the DCP cable connector.

Step 5 Replace the hex nuts onto the potentiometers and tighten. Turn the potentiometer shafts fully clockwise, then install the control knobs onto the shafts with the knob pointers at their maximum positions.

Step 6 Replace the flow pick-up tubes and the pressure port tube. Make certain that the tubes are fully engaged on the ports to which they are attached, tighten the connection with the supplied nylon wire ties.

NOTE: For units with serial numbers less than 52000, perform Reassembly Steps 1-3 of Section 6.2.20 before proceeding to Step 7.

Step 7 Replace the wraparound and feet.

Step 8 Perform the System Adjustment and Final Test procedures in Chapter 7 of this manual.

6.2.5 Transformer Replacement

Replacement Kit Number: 332180 for serial numbers less than 200,000
332554 for serial numbers 200,000 or greater

CAUTION: The appropriate Replacement Kit must be used for repairs based on the serial number of the unit. The changes that occurred to the unit can be found in Appendix F of this manual.

Repair Kit Contents	Tools Required
BiPAP transformer assembly (1) Tie wraps, ET-3 (3) 6-32 x ¼" screws (6)	Needle nose pliers Cutting pliers Torque screw driver set at 4 in-lb Loctite 222

Refer to Figures: 6-10, 6-11, 6-12

Disassembly:

Step 1 Remove the wraparound as described in Section 6.1.1, Preparing the Unit for Service.

CAUTION: The system tubing is tight. Be careful not to break the tubing ports. Use a straight firm pull to break the seal. Label the tubing to ensure proper reconnection.

NOTE: For units with serial numbers greater than 52000, perform Steps 2 to 4 of Section 6.2.20 before proceeding to Step 2.

Step 2 Remove the flow pick-up tubes (A) from the top of the blower assembly.

Step 3 **For S-D and S/T-D models only —** cut the nylon tie wrap that holds the pressure port tube on the BiPAP Control Board (BCB) pressure transducer (B). Discard the nylon tie wrap and remove the pressure port tube.

Step 4 Turn the unit upside down.

Step 5 With the torque screwdriver, remove the six Phillips head screws (C) holding the rear end cap (D) in place.

Step 6 Tilt the rear end cap away from the unit frame.

NOTE: For units with serial numbers greater than 52000, perform steps 2 to 4 of Section 6.2.22 before Step 7.

Step 7 Remove the four Phillips head screws (E) that hold the bottom plate (F) to the frame. Slide the plate out from the frame. Bottom plates on newer chassis will simply lift off the frame.

CAUTION: Before removing any wire plugs from the transformer, note the proper position of the plugs and label them for reconnection.

Step 8 Disconnect all wire plugs from the transformer (G).

Step 9 Turn the unit on its side.

Step 10 Remove the six 6-32 x ¼" screws (H) holding the transformer bracket to the frame (two screws from the top of the frame and four screws from the side of the frame).

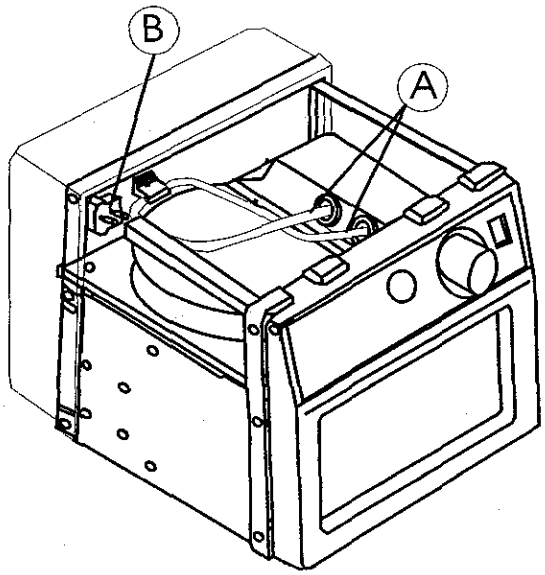


Figure 6-10

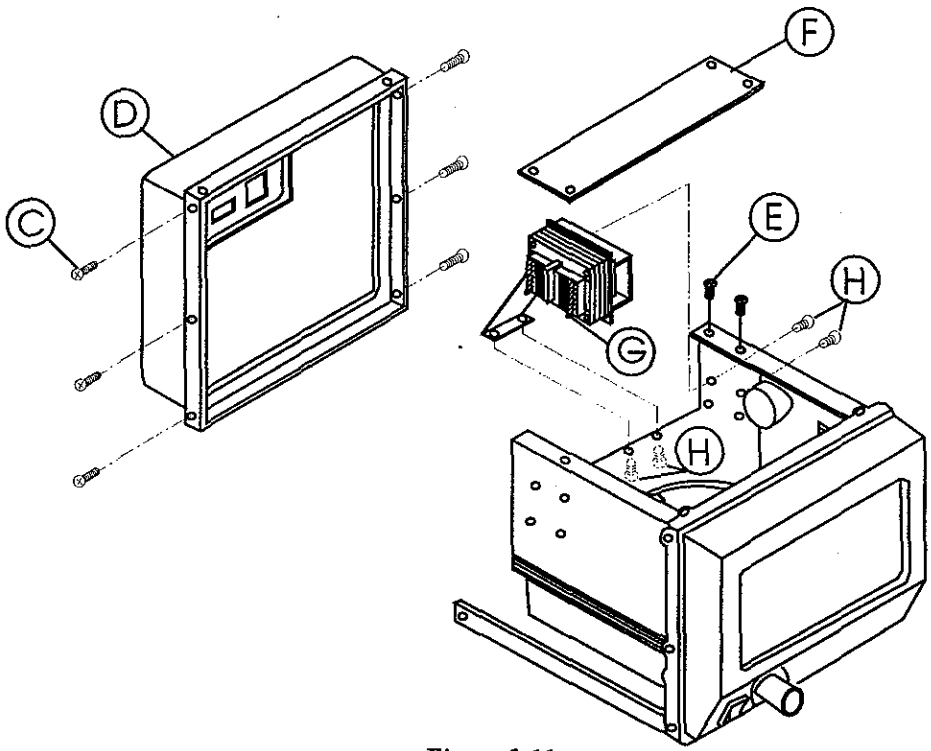


Figure 6-11

Step 11 Lift the transformer subassembly out of the unit.

Reassembly:

Step 1 Attach the new transformer subassembly to the frame using six new screws with a drop of thread sealer on the threads of the screws.

Step 2 Connect the wire plugs to the terminal, being careful to connect the plugs to the same terminals as on the original transformer. See Figure 6-12.

Step 3 Reattach the bottom plate to the unit frame with the four (six for units with serial numbers greater than 52000) Phillips head screws.

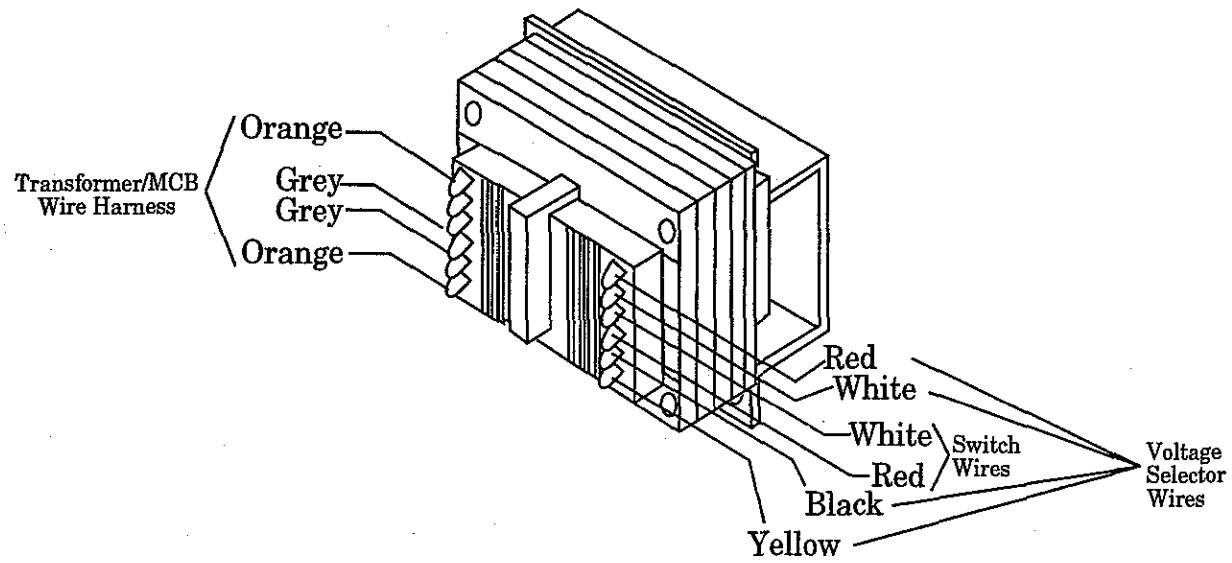
Step 4 Use the torque screwdriver to reattach the rear end cap with the six Phillips head screws.

NOTE: For units with serial numbers greater than 52000, perform Reassembly Steps 1 to 3 of Section 6.2.20 before proceeding to Step 5.

Step 5 Replace the wraparound and feet.

Step 6 Perform the System Adjustment and Final Test procedures in Chapter 7 of this manual.

For serial numbers greater than 200,000.



For serial numbers less than 200,000.

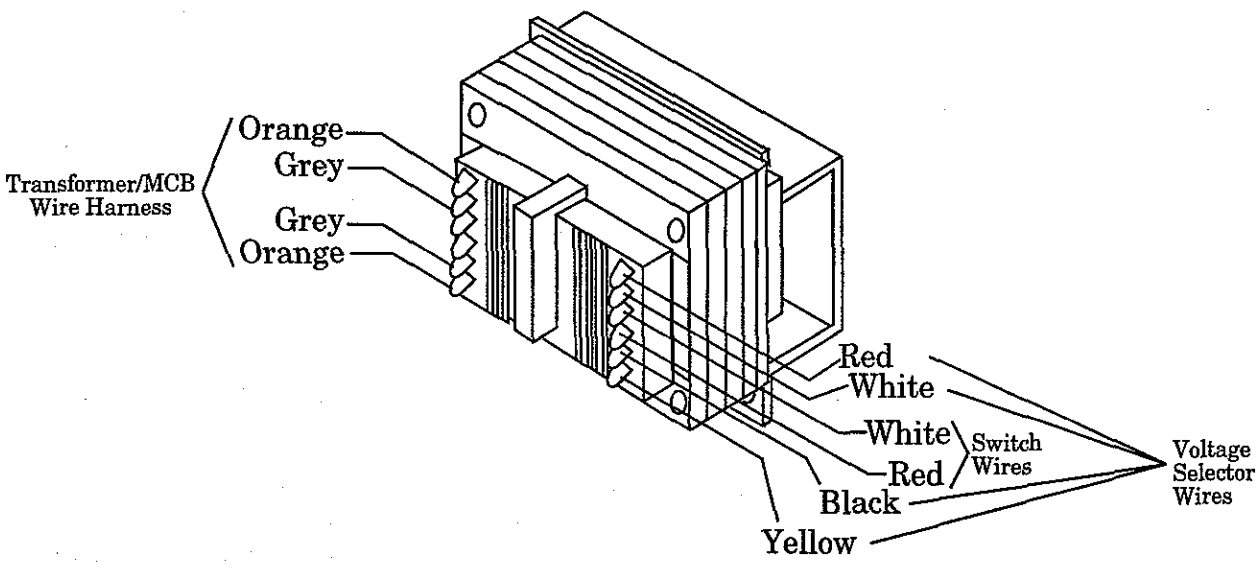


Figure 6-12

6.2.6 Muffler Replacement

Replacement Kit Number: 332471

Repair Kit Contents	Tools Required
BiPAP tube muffler assembly (1) Muffler Grommets (2) Hose clamps (2)	Needle nose pliers Cutting pliers Torque screw driver set at 4 in-lb

NOTE: Units with serial numbers greater than 80961 contain the new "tube" muffler. Replacement parts kits now contain the new tube muffler, which will replace the old square muffler. No adjustments are required to accomodate the new muffler.

Disassembly: Refer to Figures: 6-13, 6-14

Step 1 Remove the wraparound as described in Section 6.1.1, Preparing the Unit for Service.

NOTE: For units with serial numbers greater than 52000, perform Steps 2 to 4 of Section 6.2.20 before proceeding to Step 2.

Step 2 With the torque screwdriver, remove the six Phillips head screws (A) that hold the front end cap (B) in place.

NOTE: The hose clamps ratchet together. Use a slotted screwdriver to open the hose clamps.

Step 3 Remove the hose clamp from the flex connector on the blower outlet (C) and discard the clamp. Slide the flex connector off of the blower outlet.

Step 4 Losen the two nuts on the shock mounts that hold the blower down on the same side os the muffler.

Step 5 Turn the unit upside down.

NOTE: For units with serial numbers greater than 52000, perform Steps 2 to 4 of Section 6.2.22 before proceeding to Step 5.

Step 6 Remove and discard the hose clamp from the bellows at the blower inlet (D). Slide the bellows off the blower inlet.

Step 7 Move the front end cap out of the way.

Step 8 **Units with serial numbers less than 80691:** Cut, remove, and discard the tie wraps (E) on the bellows between the muffler (F) and the blower assembly.

Units with serial numbers greater than 80691: The muffler (F) does not require a bellows.

CAUTION: Use caution when removing the muffler from the valve port. Rough handling may damage the valve.

Step 9 If you are servicing an older unit, carefully separate the vibration-absorbent tape from the frame. On newer units, single-face foam is used and need not be removed.

Step 10 Slowly slide the muffler out of the valve, then slide the bellows off of the blower port. For units with serial numbers greater than 80691, the muffler does not require a bellows.

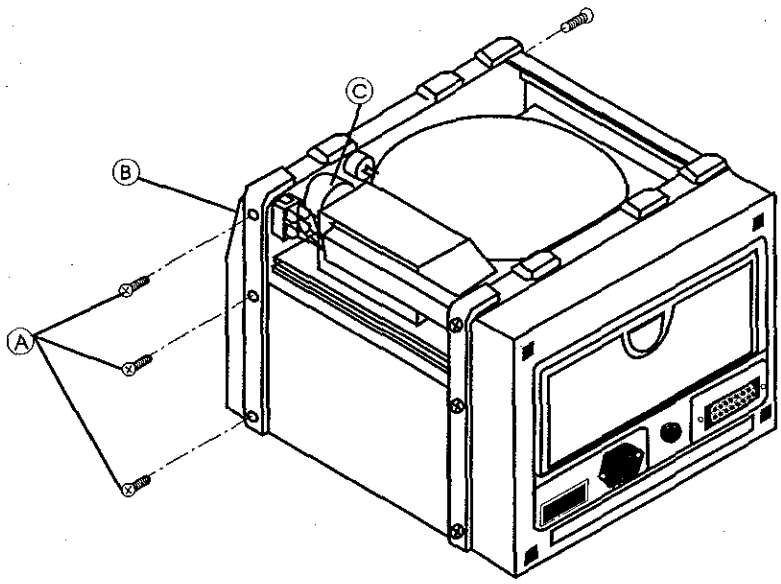
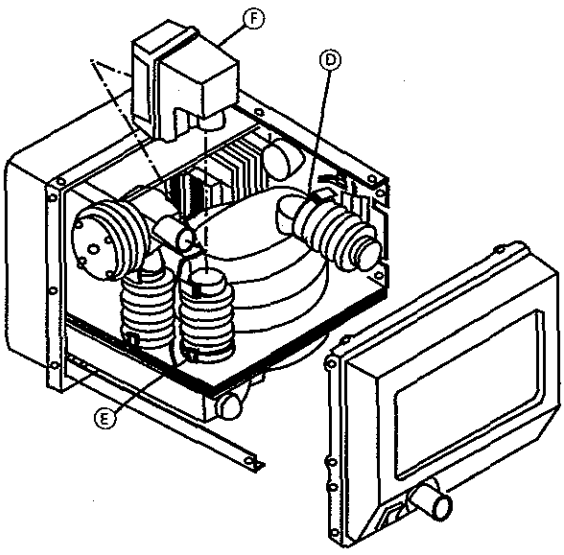
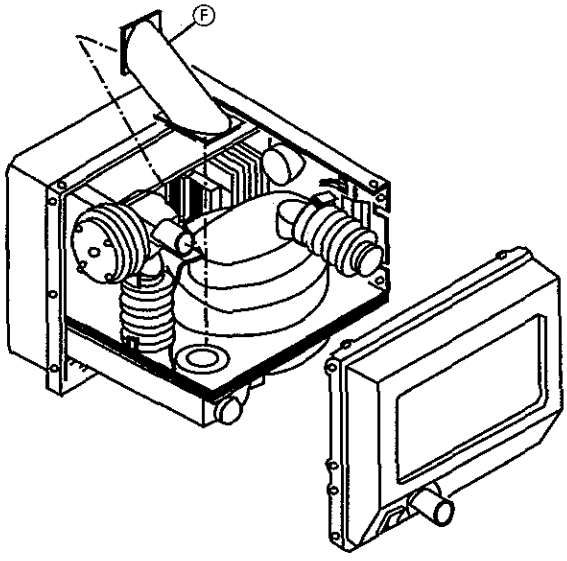


Figure 6-13



Units with serial numbers <80691



Units with serial numbers >80691

Figure 6-14

Reassembly:

Step 1 Insert the neck of one muffler grommet into each hole on the muffler. A light mist of alcohol may be used for lubrication if necessary.

Step 2 Gently push the blower away from the mounting plate to create more clearance for the muffler installation. Push the muffler onto the blower port until it is 3/16" ± 1/8" from the mounting plate. This space is necessary for proper flow.

Step 3 Attach the other end of the muffler to the valve outlet. Push the muffler onto the valve until it is 3/16" ± 1/8" from the mounting plate. This space is necessary for proper flow.

Step 4 Place blower onto the shock mounts and tighten the nuts.

Step 5 Place hose clamps on the flexible connector at the blower outlet port and on the bellows at the inlet. Ratchet the clamps until they stop clicking.

Step 6 Position the front end cap so that the flexible connector slides onto the pressure transducer and the inlet bellows slides over the blower inlet port. Apply a light mist of alcohol on the ports to ease the installation.

Step 7 Tighten both the flexible connector hose clamp and the blower inlet hose clamp.

NOTE: For units with serial numbers greater than 52000, perform Reassembly Steps 1 to 3 of Section 6.2.22 before proceeding to Step 7.

Step 8 Place the unit right side up.

Step 9 Reattach the front end cap by tightening the six screws with the torque screwdriver.

NOTE: For units with serial numbers greater than 52000, perform Reassembly Steps 1 to 3 of Section 6.2.20 before proceeding to Step 9.

Step 10 Replace the wraparound and feet.

Step 11 Perform the System Adjustment and Final Test procedures in Chapter 7 of this manual.

6.2.7 Valve Replacement

Replacement Kit Number: 332167

Repair Kit Contents	Tools Required
Electronic control valve subassembly (1) Screws, 6-32 x 1/4 Phillips truss head(4) Coupling (1)	Torque screw driver capable of 4 and 10 in-lb Loctite 222 Pliers Needle nose pliers

NOTE: The Coupling Replacement Kit, number 332533, can be used to replace the bellows between the valve and blower.

Refer to Figure: 6-15

Disassembly:

Step 1 Remove the wraparound as described in Section 6.1.1, Preparing the Unit for Service.

Step 2 Turn the unit upside down.

Step 3 With the torque screwdriver set to 4 in-lb, remove the six Phillips head screws (A) that hold the rear end cap (B) in place.

Step 4 Tilt the rear end cap away from the unit frame (C).

NOTE: For units with serial numbers greater than 52000, perform Steps 2 to 4 of Section 6.2.22 before proceeding to Step 5.

Step 5 Remove the four Phillips head screws (D) that hold the bottom plate (E) to the unit frame. Slide the bottom plate back and out of the frame. Bottom plates on newer chassis will simply lift off the frame.

CAUTION: Before you remove the valve BCB wire plug, note the proper position and orientation of the plug. Label the plug for reconnection.

Step 6 Disconnect the valve wire plug (F) from the BiPAP Control Board (BCB) (G).

NOTE: The hose clamps ratchet together. Use a slotted screwdriver to open the clamps.

NOTE: If the coupling was used no hose clamp will be present.

Step 7 For units with serial numbers greater than 153045, remove and discard the hose clamp (H) from the bellows at the valve outlet (I) and discard the hose clamp and bellows.

Step 8 Remove the four 6-32 x ¼" Phillips head screws (J) that attach the valve (K) to the unit frame.

Step 9 Carefully pull the valve away from the muffler until the valve port is clear of the muffler, then pull the valve up and away from the bellows or coupling.

NOTE: To replace the bellows with the coupling remove the bellows by cutting the tie-wraps and pulling the bellows off the blower. Tie-wraps and hose clamps are not necessary when using the coupling.

Reassembly:

Step 1 Apply a light mist of alcohol on the new valve's outlet port and slide the coupling onto the port.

Step 2 Apply a light mist of alcohol on the blower bottom and slide the other end of the coupling onto the blower bottom.

Step 3 Carefully slide the valve inlet port into the muffler.

Step 4 Attach the valve to the unit frame with four new 6-31 x ¼" screws, with a drop of Loctite 222® thread sealer on the screw threads. Tighten with the torque screwdriver set to 10 in-lb.

NOTE: Check the connections from the valve to the muffler and from the valve to the blower. These connections must be leak-free.

Step 5 Connect the valve wire plug to the BiPAP Control Board, being careful to connect the plug in the same location and orientation as before.

Step 6 Reattach the bottom plate to the unit frame with four (six for units with serial numbers greater than 52000) Phillips head screws.

Step 7 Replace the rear end cap and fasten it in place with six Phillips head screws. Tighten the screws with the torque screwdriver set to 4 in-lb.

Step 8 Replace the wraparound and feet.

Step 9 Perform the System Adjustment and Final Test procedures in Chapter 7 of this manual.

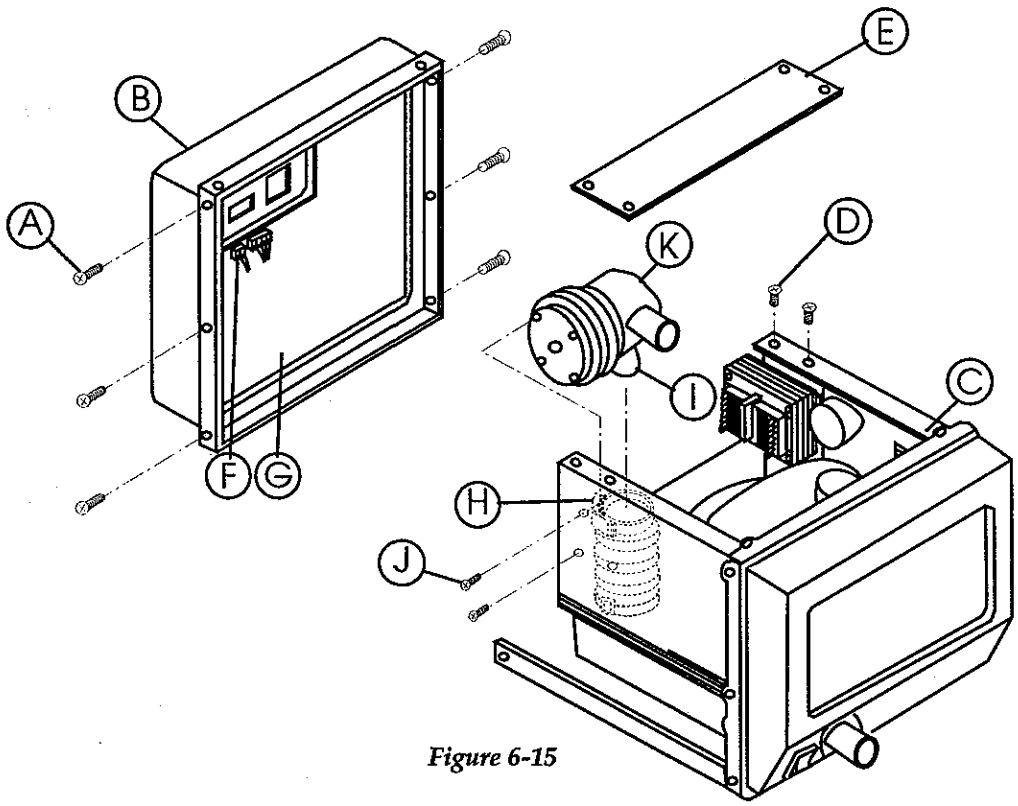


Figure 6-15

6.2.8 Flow Tube Pick-Up Tube Replacement

Replacement Kit Number: 332185

Repair Kit Contents	Tools Required
Flow pick-up tubes (2) Wire ties, ET-3 (2)	#2 Phillips screwdriver Cutting pliers

Refer to Figures: 6-16, 6-17

Disassembly:

Step 1 Remove the wraparound as described in Section 6.1.1, Preparing the Unit for Service.

NOTE: For units with serial numbers greater than 52000, perform Steps 2 to 4 of Section 6.2.20 before Step 2.

CAUTION: The system tubing fits tightly on the ports. Be careful not to break the tubing ports. Use a straight firm pull to break the seal. Label the tubing to ensure proper reconnection.

Step 2 Disconnect the defective flow tube (A) from the top of the blower assembly (B). If you are replacing both flow tubes, change one tube at a time to prevent replacing the tubes at the wrong position.

Step 3 Cut the nylon wire tie (C) that secures the tube to the pressure transducer on the BiPAP Control Board (BCB); discard the tie wrap. Pull the tube off of the transducer and discard the tube.

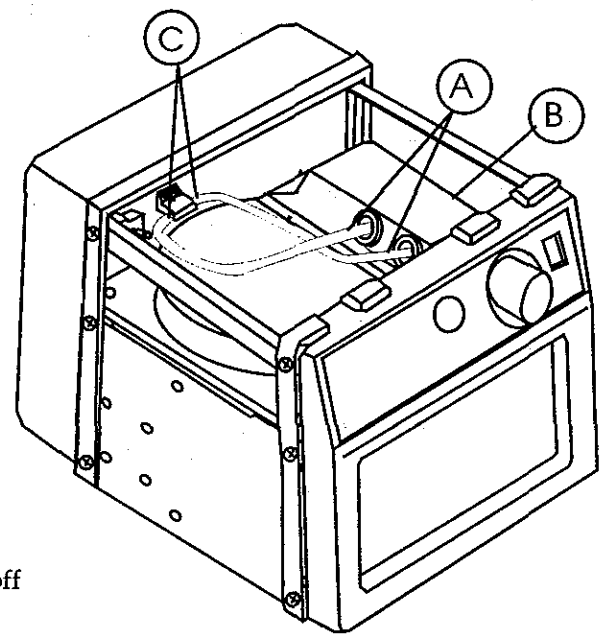


Figure 6-16

Reassembly:

Step 1 Connect the new flow pick-up tube to the BCB.

Step 2 Place a wire tie around the connection and tighten the wrap.

Step 3 Connect the other end of the tube to the top of the blower assembly.

NOTE: For units with serial numbers greater than 52000, perform Reassembly Steps 1 to 3 of Section 6.2.20 before Step 4.

Step 4 Replace the wraparound and the feet.

Step 5 Perform the System Adjustment and Final Test procedures in Chapter 7 of this manual.

6.2.9 Main Power Switch Replacement

Replacement Kit Number: 332163 (lighted) or 552127 (non-lighted)

Repair Kit Contents	Tools Required
Main power switch (1)	#2 Phillips screwdriver Needle nose-pliers

Refer to Figures: 6-16

Disassembly:

Step 1 Remove the wraparound as described in Section 6.1.1, Preparing the Unit for Service.

NOTE: For units with serial numbers greater than 52000, replace Step 2 with Steps 2 to 5 of Section 6.2.21, but only remove Side Panel "E."

Step 2 Remove the Phillips screws (A) that retain the cross bar (B) that is nearest the main power switch (C). Remove the bar.

CAUTION: Before disconnecting the switch wire plugs, note the position of the plugs and label for reconnection.

Step 3 Disconnect the switch wire plugs (D) from the switch using needle-nosed pliers.

Step 4 Depress the mounting tabs on the top and bottom of the switch and push the switch out of the front end cap.

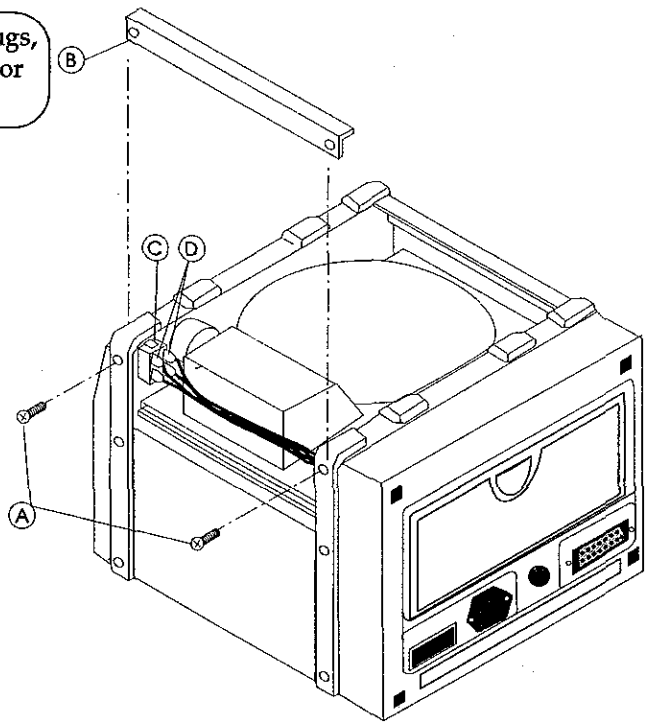


Figure 6-17

Reassembly:

Step 1 Push the new switch into the front end cap from the front. Be sure to orient the switch such that the "I" is on the top.

Step 2 Reconnect the switch wires to the power switch.

NOTE: For units with serial numbers greater than 52000, replace Step 3 with Reassembly Steps 1 to 5 of Section 6.2.21.

Step 3 Replace the cross bar and secure it with the two Phillips head screws.

Step 4 Replace the wraparound and feet.

Step 5 Perform the System Adjustment and Final Test procedures in Chapter 7 of this manual.